# AIR ENGINEERING

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APRIL, 1961

MAKING AIR COMFORTABLE, HEALTHFUL, SAFE, AND USEFUL FOR PEOPLE, PRODUCTS, PROCESSES


- *How Safe Is Your Industrial Ventilation? — P. 24*
- *Four Ways To Ventilate Production Centrifuges — P. 31*
- *Odor-Free Incineration For Modern Hospitals — P. 33*
- *Smoke-Free Coal Fired Power Generation — P. 37*

**Super-Clean Rooms For Super Clean Klystrons—See Page 20**

# NEW! DRI-Pak SERIES 2000

## ...a high-efficiency unit filter from AAF!

**95** sq. ft. of filtering media in one unit!..... 8-inch-deep carton...holds two filters...each weighing just 4 lbs.!

**New dry-type unit offers unmatched combination of air filter advantages.** AAF's new DRI-Pak Series 2000 air filter combines high efficiency, low resistance, compactness and large dust-holding capacity to a degree unequalled by any other dry-type unit filter.

The secret is in its unique "windsock" operation. The "tubes" of the glass fiber media inflate to a 36-inch depth when the system is in operation, but collapse when the system is shut down! This collapsing feature eliminates the need for rigid back-up wire grid and the possibility of damage to the cartridge during servicing.

Filter maintenance amounts to nothing more than infrequent replacement of the DRI-Pak cartridge. And the plenum for a bank of DRI-Pak filters need be very little deeper than the filter's 36-inch inflated depth because almost the total space can be used as access to washer, coils, etc., when the system is shut down.

The AAF DRI-Pak is available in 24″ x 24″ or 12″ x 24″ sizes.

For complete product information on the new DRI-Pak air filter, call your local AAF representative or write us direct for Bulletin No. 228. Address: Mr. Robert Moore, American Air Filter Company, Inc., 305 Central Avenue, Louisville, Kentucky.

AAF **American Air Filter**

BETTER AIR IS OUR BUSINESS

# AIR ENGINEERING

VOL. 3, NO. 4

APRIL, 1961

MAKING AIR COMFORTABLE, HEALTHFUL, SAFE,
AND USEFUL FOR PEOPLE, PRODUCTS, PROCESSES


## FEATURES


**Super-Clean Rooms For Super-Clean Klystrons 20**

*by G. V. Freeman, plant engineer, Litton Industries. Air handling, air cleaning, room design, construction and layout, in super-clean air facility at this radar tube manufacturing facility.*

**How Safe Is Your Plant Ventilation? 24**

*by E. M. Schmidt, chief mechanical engineer, Ford Motor Co. How Ford designs and specifies air handling equipment, including make-up air units.*

**Size And Space Needs of Electrostatic Precipitators 29**

*by Robert L. Brown, senior contract engineer, Industrial Gas Cleaning Dep't., Koppers Co., Inc. How air cleaning performance specifications affect size of unit.*

**Four Ways To Ventilate Production Centrifuges 31**

*by William V. Andresen, chief plant engineer, American Cyanamid Co. Hood design, and ventilation for underdriven and overdriven centrifuges in chemical processing.*

**New Trends In Hospital Incinerator Design 33**

*by Morgan C. Larkin, Nash, Cadmus and Voelker, Inc. How changing pattern of hospital wastes, with higher thermal values, requires new types of incinerators for odor and smoke free burning.*

**Dust Collection Methods For Steam Power Plants 37**

*by Gregory Gould, President, Fuel Engineering Co. Use of various types of collectors, both electrical and mechanical, individually and in combination, are described in this first of a two-part series.*


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COVER

*Super-clean room at Litton Industries' Electron Tube Div. Klystron microwave tubes are assembled under ultra-clean air conditions in this room. See page 20 for story.*


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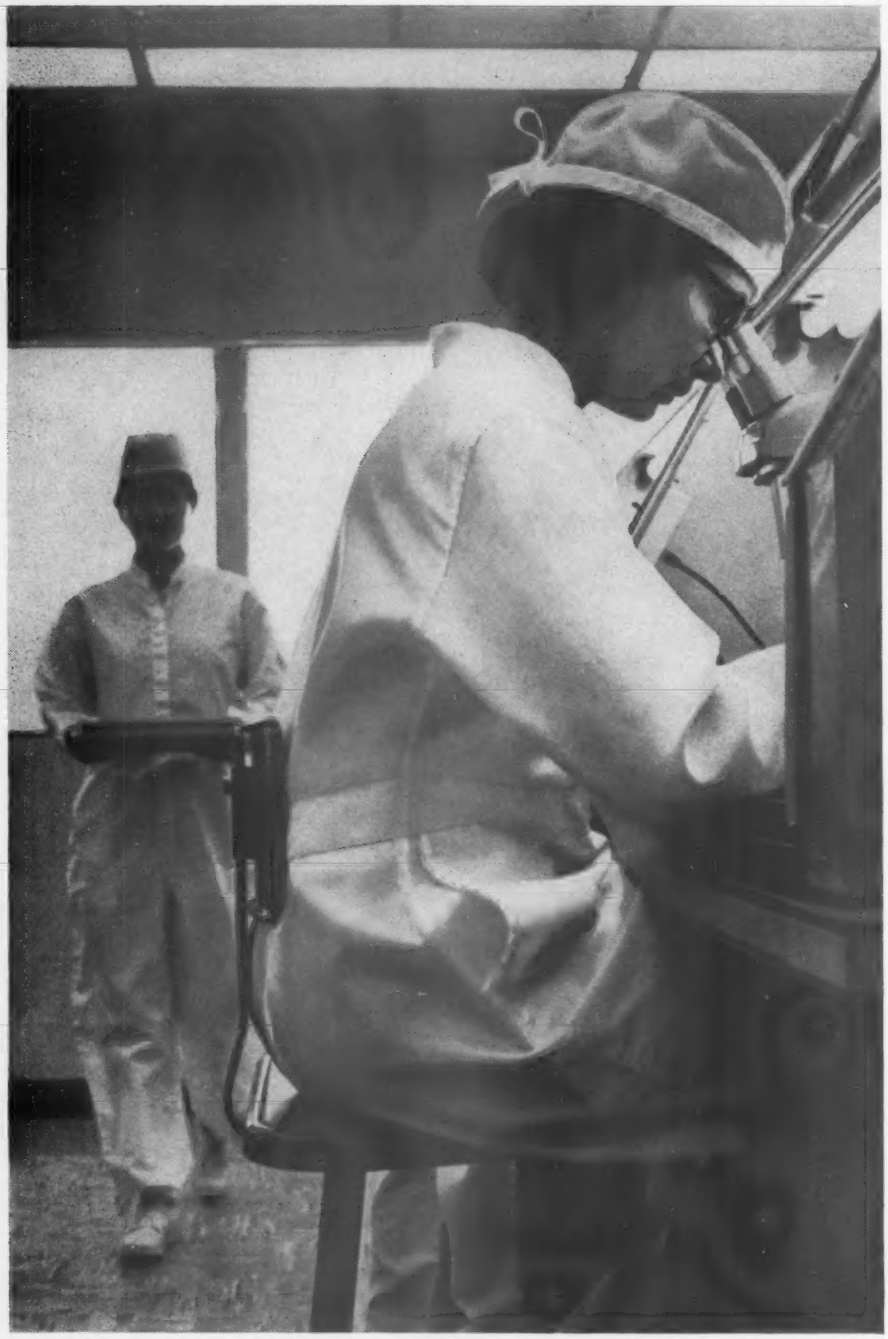

Precision operations like those at The Barden Corp. require rigid quality standards. Lint problems have been greatly minimized with uniforms of "Dacron".

# FOR LINT-FREE UNIFORMS
## it's DACRON® polyester fiber

Uniforms of filament "Dacron"* polyester fill a very real need where quality control is required. The smooth surface of filament "Dacron" *cannot* generate lint and thus contributes to White Room cleanliness. And "Dacron" does much more for uniforms—builds economy through long wear and minimum upkeep.

Uniforms of "Dacron" also lend themselves to either commercial or home laundering. So remember, efficient White Room maintenance is not really complete without the clean, fresh, lint-free benefits that uniforms of "Dacron" provide.

**FOR SPECIAL ADVICE ON UNIFORMS**, write: Uniform Counseling Service, E. I. du Pont de Nemours & Co. (Inc.), Textile Fibers Dept., Centre Road Bldg., Wilmington 98, Del.

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# Letters

### Attention, Consulting Engineers! Firm Bid Price Or Fee?

**Editor:**

In selecting consulting engineers to design mechanical and electrical systems for public buildings, such as schools, is it proper to ask the consulting engineer to submit firm bid price for rendering engineering design . . . instead of on a fee basis?

*F.H.V.*
*Ohio*

### Your Reactions Invited

*Editor's Note:*

*Your comments as to F.H.V.'s question, above, are most welcome. Any consulting engineer . . . or consulting engineer's client, is most welcome to send in his views on whether payment for professional services by engineers should be made on a firm bid price or fee basis. We can think of several pros and cons . . . can you?*

---

### "In Praise of Industrial Hygienists"

**Editor:**

Thank you for the September issue of AIR ENGINEERING bearing your editorial "In Praise of Industrial Hygienists." I showed your editorial to the Board of Directors of the Chicago Section of American Industrial Hygiene Association. They had asked me to express my appreciation to your promoting our field of work.

*J. T. Siedlecki*
*Chicago, Ill.*

---

### White Room Future

**Editor:**

I receive a copy of AIR ENGINEERING through my company, but to insure that all issues and your literature get through to me, I just subscribed to another issue of AIR ENGINEERING which is to be delivered to my residence.

Will you please send a copy of the White Room directory to my home address?

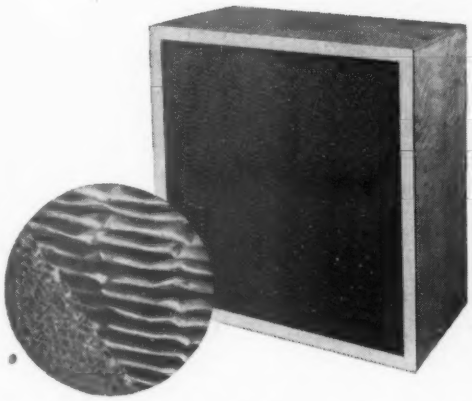
*(Please turn to page 9)*

# Mine Safety Appliances Company

201 North Braddock Avenue, Pittsburgh 8, Pennsylvania

## MSA:

### Fluid Purification Equipment / Fluid Purification Specialists for 45 years

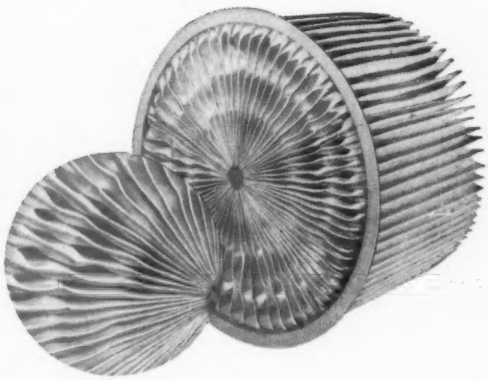


**M-S-A® UltraAire* Space Filter**

Lightweight, fire-resistant, unusually strong, and ideal for high humidity service. Individually pretested and proved at least 99.97% efficient in removing particles of 0.3 micron diameter.

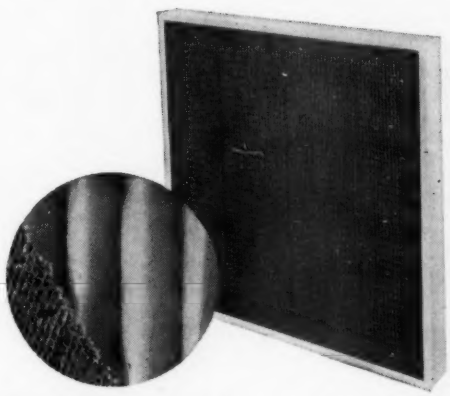
**M-S-A® Dustfoe* Space Filter**

Offers the efficiency of an Electrostatic Precipitator without the high cost and without the possibility of arcing "blow-off." 85-95% certified efficiency on NBS Atmospheric Air Dust Stain Rating.



**M-S-A® Cylindrical-Type UltraAire* Space Filter**

Honeycomb-type fold without separators is admirably suited to cylindrical element construction. This shape is preferred for pressure systems and round ducts. Easy to handle. Inexpensive to ship.



**M-S-A® Air-O-Kay* PreFilter**

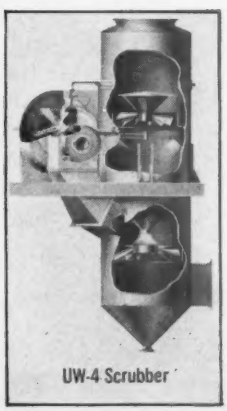
Impingement type panel prefilter which can be used oiled or dry to remove lint and other large airborne particles from the atmosphere. 60-70% certified efficiency on NBS Stain Rating.

*Trademark

Write for illustrated technical bulletins on M-S-A Space Filters related to your particular system problem. Ask an MSA Representative for system recommendations. Mine Safety Appliances Company, Pittsburgh 8, Pa., Phone: CHurchill 1-5900.

Other Fluid Purification Equipment includes catalytic filters for jet aircraft cabin air; air separation plants; inert gas generators; space capsules; bomb shelters; air line filters; jet fuel and hydraulic fluid purification.

# dustophobia...




**ITS CAUSE AND CURE**—There are three schools of thought on the cause of Dustophobia. Psychologists say it's psychological, physicians claim it's physiological. We side with the third viewpoint which holds that people hate dust because it's just plain dirty! ■ The cure? Again a divergence of opinion. Hypnosis has been suggested by the psychologists; antihistamines proposed by the physicians. ■ Our solution? Get rid of the cause . . . with Ducon Dust Collectors, naturally! There's a Ducon cyclone, scrubber or filter for almost every dust control application. They are efficient . . . economical . . . and a sure cure for Dustophobia. Particularly in the vicinity of your plant. Send for Bulletin A-9159 describing Ducon's Line of Dust Recovery equipment.

DUST CONTROL SYSTEMS AND EQUIPMENT — DUCON

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**EDITORIAL:**

# *A New Breed of Plant Engineer?*

THE "BULL OF THE WOODS" type of plant engineer is fast becoming as extinct as the dodo bird. He's just as canny about things mechanical as the "old man" ever was, and his modern counterpart knows a whale of a lot more about the effects of industrial processes on worker health, insofar as it lies within his power to keep these processes from harming the worker.

War-spawned production techniques, now spread throughout all industry, plus new knowledge about the myriad effects of toxic fumes, dusts and gases on worker health, add up to a need for far more knowledge about air engineering of indoor climate than had ever been required of the old-line plant engineer.

This new interest, a "third dimension" in plant engineering, the vital need to provide a healthful climate in which the worker can perform at top efficiency, is sparked not only by fierce competition for the consumer dollar.

This new outlook *had* to come to plant engineers . . . just as certainly as the manufacturing processes that make it necessary. It's just as important for today's plant engineer to be concerned with providing proper ventilation safeguards for new processes, as it is for him to see that the equipment involved is properly installed and operating.

For example, it's as much the plant engineer's job to provide proper ventilation safeguards for plasma jets, as it is to provide safety precautions for other hazards associated with this equipment, such as explosion.

That it may be unlikely for the plasma jet to explode is beside the point . . . if *whatever* new type of equipment installed by the plant engineer has embodied within its design or use a potential health hazard that can be eliminated by the techniques of air engineering . . . this then falls within the province of our modern plant engineer to handle at the outset.

We are certain that as industrial processes become more complex, as new materials and methods are adapted, the plant engineer who ignores air engineering for worker protection and comfort demanded by these new processes and materials . . . is not long for this modern world.

Some of the new plastics, for example, that have

*(Please turn to following page)*

## Editorial *(Cont.)*

*(Continued from preceding page)*

found widespread use in recent years, such as polystyrene, phenol formaldehyde, plastics containing chlorine, fluorocarbon polymers or resins, may give off hazardous thermal decomposition products when heat is applied to them during welding, cutting or burning (plastics used as corrosion preventive coatings on metal). The relatively new airless spray painting technique exposes workers to high concentrations of finely divided paint pigments and solvents. Modern plant engineers must provide ventilation systems for these hazards.

An atom age problem relates to reclaiming steel scrap containing uranium. This can be done without worker hazard if proper ventilation is provided . . . again, a function of the plant engineer in the steel reclaiming facility. Another relates to manufacture of jet aircraft, where many of the production processes pose health problems requiring ventilation . . . notably in fuel tank cleaning and sealing, hydraulic system testing and spray painting with the new epoxy resin paint formulations.

New chemical compounds, or new uses for old ones, pose health hazards if proper ventilation precautions aren't recognized in time. Such a chemical is n-butylamine, whose vapors can be toxic. It's used in dye stuffs, rubber chemicals, flotation agents, corrosion inhibitors, insecticides.

Radioactive substances in industry, literally hundreds of other products and processes, are all appearing on the factory horizon. And with these products a new breed of plant engineer is also emerging . . . the air engineer who knows how to apply the techniques of ventilation, air conditioning, indoor climate control, for the safe, efficient manufacture of these new goods and materials, in this age of the peaceful atom, the germanium transistor, the micro-world of miniaturized products. ▲▲

Eugene A. Sloane

Editor

# Meetings, Courses, Expositions

**Gas Appliance Manufacturers Assn.,** *Boca Raton Hotel, Boca Raton, Florida, April 5-7, 1961.*

**American Industrial Hygiene Conference,** *Sheraton-Cadillac Hotel, Detroit, April 10-13, 1961.*

**7th National ISA Symposium on Instrumental Methods of Analysis,** *Shamrock-Hilton Hotel, Houston, Texas, April 17-19, 1961.*

**39th Annual Convention of the Oil Heat Institute of America,** *Statler-Hilton, Washington, D. C., April 23-27, 1961.*

**National Assn. of Electrical Distributors (annual convention),** *Detroit, April 29-May 3, 1961.*

**Consulting Engineers Council,** *Chicago, Illinois, May 4-6, 1961.*

**4th National ISA Power Instrumentation Symposium,** *LaSalle Hotel, Chicago, May 8-10, 1961.*

**12th Annual National Conference of the American Institute of Industrial Engineers,** *Sheraton Cadillac, Detroit, May 11-13, 1961.*

**Industrial Heating Equipment Association, Inc.,** *The Homestead, Hot Springs, Virginia, May 21-24, 1961.*

**5th Annual Industrial Hygiene Conference,** *Midland, Michigan, May 24, 1961.*

**Air Pollution Instrumentation Symposium,** *Hotel Commodore, New York, June 12, 1961.*

**Electrical Precipitation Seminar,** *The Pennsylvania State University, University Park, Pennsylvania, June 12-17, 1961.*

**3rd Biennial International Gas Chromatography Symposium,** *Kellogg Center, Michigan State U., East Lansing, Mich., June 13-16, 1961.*

**4th International Conference on Bio-Medical Electronics; 14th Conference on Electronic Techniques in Medicine & Biology,** *Waldorf-Astoria Hotel, New York, July 9-14, 1961.*

**Atomic Shelter Seminar,** *The Pennsylvania State University, University Park, Pennsylavnia, July 10-22, 1961.*

**Joint Nuclear Instrumentation Symposium,** *North Carolina State College, Raleigh, N. C., Sept. 6-8, 1961.*

**Production Engineering Show,** *Navy Pier, Chicago, Illinois. September 6-16, 1961.*

**ISA Fall Instrument-Automation Conference & Exhibit,** *Memorial Sports Arena, Los Angeles, Calif., Sept. 11-15, 1961.*

**National Metal Exposition,** *Detroit, October 23-27, 1961.*

**First International Convention on Ionization of Air, Technical, Physical and Physiological Aspects,** *Ben Franklin Institute, Philadelphia, Pennsylvania, October 16-17, 1961.*

**National Frozen Food Distributors Assn.,** *Chicago, Nov. 6-10, 1961.*

**Air-Conditioning and Refrigeration Institute (annual meeting),** *The Homestead, Hot Springs, Virginia, Nov. 12-15, 1961.*

**National Warm Air Heating and Air Conditioning Assn. (annual convention),** *La Salle Hotel, Chicago, Nov. 13-16, 1961.*

**National Electrical Manufacturers Assn. (annual meeting),** *Traymore Hotel, Atlantic City, New Jersey, Nov. 13-17, 1961.*

**National Assn. of Home Builders,** *Exposition Center, Chicago, Dec. 3-7, 1961.*

# Letters

*(Continued from page 4)*

I share your conviction that the interest in White Rooms is staggering. White Rooms are here to stay and we're currently looking at just the beginning.

*Irving M. Kodel*
*Manufacturing Development Engineer*
*Sandia Corp.*
*Albuquerque, New Mexico*

---

## Good Air Pollution Articles Welcomed

**Editor:**

May I congratulate you on your fine article in *House Beautiful* magazine of January, 1961.

Will you make up reprints of this article for resale to Air Pollution Departments in the near future? We need articles such as this for general distribution because of its broad explanatory field.

Will you see that we are all notified, if it is possible to secure this article.

*John E. Clausheide*
*Smoke Commissioner*
*Evansville, Indiana*

*Note:* Reprints are available through *House Beautiful.*

---

## November Article A Selling Aid

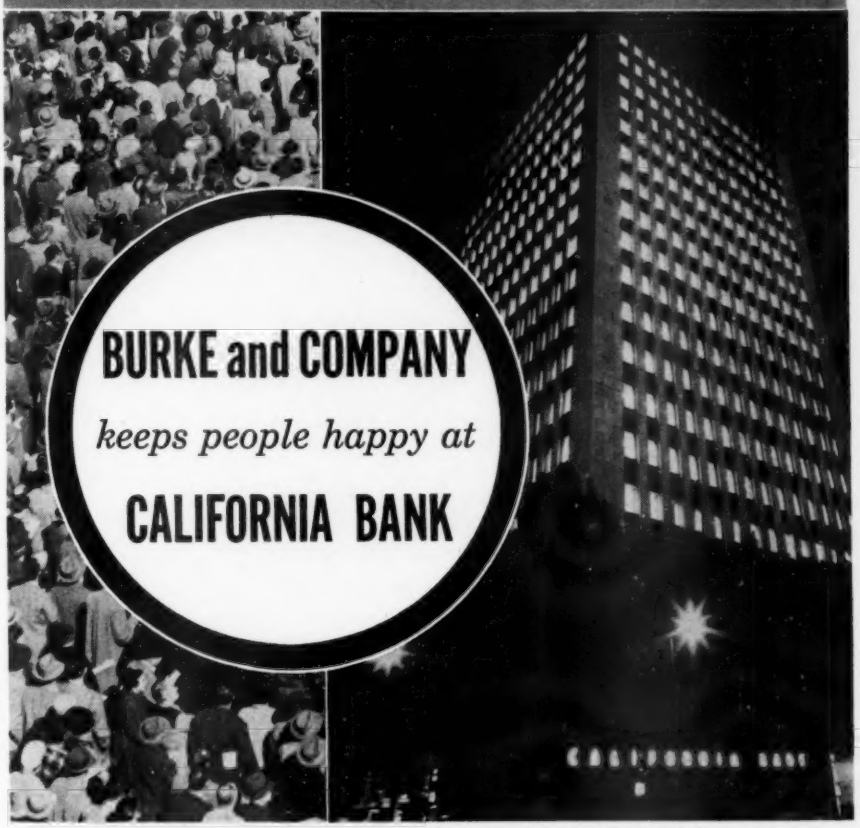
**Editor:**

Your November, 1960 issue of AIR ENGINEERING contained an excellent article about the "clean rooms" at the McDonnell Aircraft Company's plant in St. Louis, Missouri. In this article there was reference to the shoe cleaning device installed in the floor. This device, as you may know, is the Miracle Mat. Copies of this article would be a great help in our efforts to convince electronics firms and others in this area of the efficiency of Miracle Mat for clean room operations.

Therefore, I would greatly appreciate information on the availability of reprints of this article,

*(Please turn to page 11)*

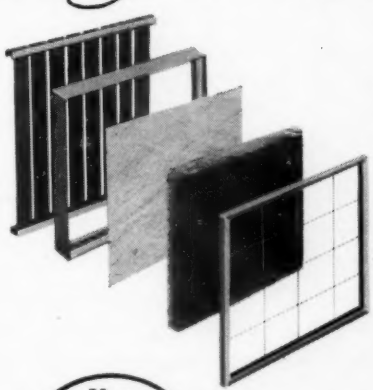

Where people gather...CLEAN PURE AIR is VITAL




ARCHITECT — Claud Beelman & Associates • GENERAL CONTRACTOR — C. L. Peck Construction & Realty Co. of Los Angeles • AIR CONDITIONING CONTRACTOR — Air Conditioning Company • MECHANICAL ENGINEERS — Kilpatrick & Company.

● Good customer relations require an atmosphere of clean, pure air for both patrons and employees. That's why in the new California Bank Building in Los Angeles ROTO AIRE replaceable media air filters, as well as both total and partial detention type gas and vapor adsorbers by Burke are being used.

ROTOAire® FILTERS STOP AND HOLD DIRT!
ACTIVATED CHARCOAL FILTERS PURIFY AIR!



Here are advance design air filters and air purifiers that are highly efficient, effective and dependable.

They are readily adaptable to all new or existing installations.

They are available in a wide variety of sizes.

They may be operated at varying velocities and with various combinations of media.

The initial cost is low, but even more important . . . the maintenance cost is low.

*You can specify* ROTOAire® PRODUCTS *with confidence!*

**Write for Technical Data Bulletin and "Economic Analysis."**

*Selected Territories Available For Qualified Representatives*

BURKE *and* COMPANY
2902 Hyde Park Blvd., Los Angeles 43, California

# AIR ENGINEERING Newsletter

MAKING AIR COMFORTABLE, HEALTHFUL, SAFE, AND USEFUL FOR PEOPLE, PRODUCTS, PROCESSES

### *Approximately $500,000,000 Spent A Year On Air Pollution Control*

Granville A. Howell, assistant to the administrative vice president of engineering for the United States Steel Corp., estimates that $500,000,000 a year is being spent by industry on equipment to control air pollution.

---

### *Engineering Construction Awards 10 Percent Over Last Year*

In the first 10 weeks of 1961 engineering construction awards were 10 percent higher than last year at that time. This was achieved in spite of a drop of $106-million in mass housing contracts.

It seems the emphasis is gradually shifting from private to public projects. Yet private construction is strong in office buildings, hotels, and industrial plants.

---

### *New Jersey Moving Slow But Sure To Clean-Up Air*

New Jersey Governor Robert B. Meyner answered New York officials who have charged that New Jersey is not doing its share to eliminate air pollution in the metropolitan area.

The Governor said that to move too fast in eliminating pollution could prove detrimental to industrial expansion. He stressed that New Jersey was a leading producer of pharmaceuticals and petroleum products and that certain "obnoxious but otherwise harmless" odors were unavoidable.

---

### *Clams Return To The Beach And Cause Air Pollution Problem*

Atlantic City Beach Commissioner W. F. Casey solved the problem of "smelly" clams permeating the city by burying them in the beach.

Casey said the outbreak of clams washed up on the beaches was the first since last summer.

---

### *Trane Company Reports 1960 Profits $1,685,686 Over 1959*

Increases in both sales and profits for 1960 were reported by The Trane Company, manufacturer of air conditioning, heating, ventilating, and heat transfer equipment.

Consolidated sales in 1960 were $102,461,451, up from $84,112,872 in 1959.

Profits were $6,711,635, up from $5,025,949 in 1959.

President D. C. Minard said that Trane is planning for a modest sales increase in 1961.

---

### *California Farmers Suffered An $8 Million Loss From Heavy Smog*

A legislative committee has found that last year farmers in California suffered direct losses from smog totaling $8 million.

Because air pollution delays the ripening-process and lowers yields and quality, farmers in 25 California counties have been affected by the smog.

---

### *New York Air Pollution Rate Dropped 66% During Vehicle Ban*

During the heavy February snowstorm in which vehicles were banned in New York for 6 days the air pollution rate dropped 66 percent.

Air Pollution Commissioner A. J. Benline said "This reduction was especially important, because during five of the six days of the ban, there were temperature inversions (condition which keeps smog and like conditions close to the ground) in the city, which normally would have resulted in extremely high pollution readings."

# Letters

*(Continued from page 9)*

and rates for quantities of 500 or more. In addition, I would like to receive information on subscription rates and a back copy of the November issue, if one is available. I have not personally had the enjoyment of reading your publication to date, and judging by the reports I have had, I am missing an informative and well written magazine.

*J. J. Guilderson*
*General Manager*
*The Miracle Mat Company*
*Winchester, Mass.*

## "Directory Of Supplies And Equipment For White Room"

**Editor:**

It has been brought to the attention of our division that your October 1960 issue of AIR ENGINEERING magazine carried a list of companies manufacturing "white room" equipment.

We are most anxious to receive such a list. We are encountering some difficulty in obtaining the correct address where this list may be obtained so we hope we are contacting the proper party this time and we would be very grateful to you for any help you may offer.

Two copies of the above list would be very helpful, but we would be grateful to obtain at least one.

*Carl F. Schultz*
*Edgewood Ave.*
*Walpole, Mass.*

*To receive a copy of the "Directory of Supplies and Equipment for White Rooms"*

**Circle #200 on page 51.**

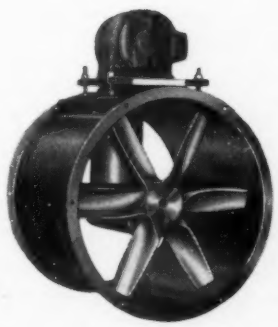
## Professional Men Benefitted By AIR ENGINEERING

**Editor:**

Your magazine has done much to cause professional men to consider improvements and applications. As one who has benefitted considerably by contact with your journal, please accept my thanks and congratulations for your fine publication.

*M. J. Adamson*
*Los Angeles, Calif.*

**that Hartzell Duct Fans offer high efficiency, low maintenance and UNIQUE FLEXIBILITY**

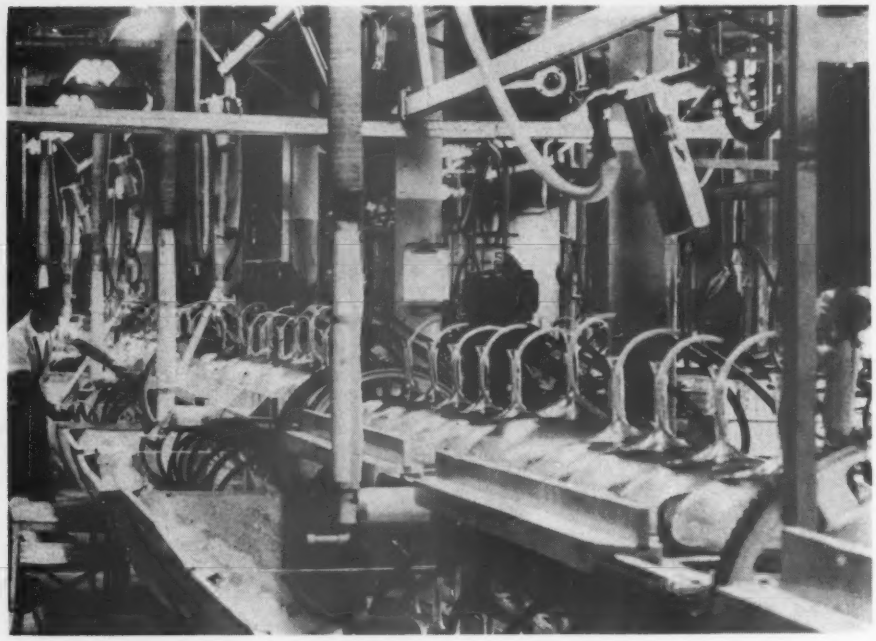


High efficiency, low maintenance . . . *and* unique flexibility made possible by the use of variable pitch drives which allow you to vary fan speed and air delivery by up to ⅓ through simple adjustment of the driver sheave. That's why Hartzell duct fans are so widely used in industrial duct systems. And these fans are so easy to install, they bolt right into any duct system as quickly and simply as another section of duct work. Belt-drive and direct-connected models in sizes from 12" to 60", plus special Bi-Pass model which can be used to handle air at temperatures as high as 550° F.

For complete details, just give your nearby Hartzell engineer a call. You'll find him listed in the Yellow Pages or in the Hartzell catalog in Sweet's Plant Engineering and Industrial Construction Files.

Hartzell PROPELLER FAN COMPANY
Division of Castle Hills Corp. • PIQUA, OHIO
(HARTZELL)

# NEWS of the Industry



A general view of the tube production department at Thomas Electronics. Each hose on the settling table is connected to a filter.

## Filtered Air a Must In the Production of TV Tubes

Over 500 dry-type air filters are being used by Thomas Electronics, Inc., in the production of nearly 6,000 cathode ray tubes daily. The filters clean dehumidified air which is used to dry and harden the luminescent screens. Zinc sulfide phosphor crystals are permanently bonded to the inside of the tube to form the picture surface.

To promote good drying it is essential that the high volume air flow be free of impurities. This is accomplished with filters right at the point of use, as the drying air enters the bulb.

Manufactured by Purolator Products, Inc., the dry-type unit eliminates the need for a special ball valve which was used to cut off air flow through the previous filter because it restricted air passage when operating under normal air pressures.

The line for cathode ray tubes utilizes the filters after the glass bulb has been filled with a clean water mixture containing zinc sulfide phosphor and other chemicals.

The glass bulbs are held on tilting tables until the phosphor has settled to the inside face of the bulb and then inverted causing the water to pour out of the neck. Filtered clean air is injected into the bulb at atmospheric pressure to prevent any bubbling action which would wipe the phosphor from the bulb face.

After the bulbs are inverted warm dehumidified air is forced through the same filters to dry the screen and assure a uniform bond. After drying, the bulbs are automatically conveyed to the subsequent operations required to produce television picture tubes.

## *Prevents Air Pollution During Construction*

Since Chicago's Air Pollution Ordinance was established in 1959, the Air Pollution Control Department has initiated an effective program to halt air pollution. One of the primary functions of the Department is to prevent the creation of air pollution problems while a structure or process is being built. The permit and plan review sections of the Department do this while the process or structure is in the blueprint stage. Following are listed a few of the typical control applications used:

Bag house collectors have been applied for the control of dust from sand blast operations, also to storage and loading operations of bulk cement;

Mechanical collectors have been applied for control of dust in grain and flour handling;

Hydrostatic precipitators have also been applied to control discharge of particulate matter in other mechanical operations;

Multi stage scrubbers have been applied successfully to prevent the discharge of acid fumes from plating operations, etc.;

Fumes and odors have been abated by incineration; catalytic and direct flame;

Odors created by gaseous contaminants have been eliminated by use of activated charcoal filters.

As taken from the "City Of Chicago Department Of Air Pollution Control 1959 Annual Report."

## *New Power Group Has Been Organized*

During the January meeting of the National Electrical Manufacturers Association, a new Unconventional Power Generation Section was organized. The latest most advanced technical industry group to affiliate with the NEMA will have the following products in its scope: magnetohydrodynamics (MHD); fuel cells; thermoelectric; thermionics; batteries; photovoltaics; and photochemicals.

A five-man Program Committee, headed by Dr. Manfred Altman, Consulting Engineer, Missile-Space Vehicle Department, General Electric Company, was appointed to prepare recommendations to the Section at an early date concern-

*(Please turn to page 14)*

If your present dust control system is not delivering maximum efficiency, you may be paying an exorbitant price for dust. It's a mighty expensive item when you consider the damaging effect on equipment, on employee morale, on general plant appearance and community relations. The most practical and *economical* solution of any nuisance dust problem is the MIKRO-PULSAIRE Collector, now available in new flexible modular units designed to meet any required capacity however large or small . . . attested recovery efficiency 99.9% plus . . . absolutely no moving parts, internally or in the gas stream . . . 4 or 5 times the capacity of conventional bag houses per unit of cloth area. For the toughest nuisance dust collection jobs, call on our engineering staff, and the MIKRO-PULSAIRE.
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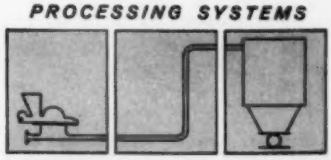
PROCESSING SYSTEMS

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# NEWS of the Industry . . .

*(Continued from page 12)*

**Power Group**

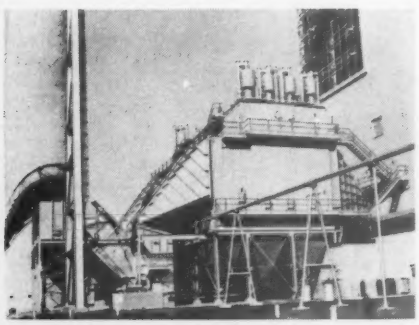
ing proposed Section activities. Early projects probably will deal with Government contacts and the development of Standards for basic terms, definitions and tests.

It is expected that invitations will be extended, at an early date, to companies in this field which are not presently members of NEMA to join the Association and affiliate with the new Section.

## 99% Efficiency In Cleaning Stack Gas

An efficiency of 99 percent in removing dust and fly-ash from boiler combustion gases is now being achieved by a large Connecticut utility during operation of its new 150,000 Kw generating station. The combination electrical and mechanical precipitators designed and built by Research-Cottrell, Inc., Bound Brook, N. J. place the large new generating station in the ranks of power plants with smoke cleaning efficiency of 99 percent or better.

About 1,120,000 cubic feet per minute of stack gases are cleaned by the precipitators from the unit's pulverized-coal fired boiler. The forced-circulation boiler generates up to 1,150,000 pounds of steam per hour to power the 150,000 kilowatt turbogenerator. Ash in the combustion gases is collected by the electrical precipitators after



leaving air preheater at 261°F. The hot gas then enters Cyclotrell mechanical collectors which whirl out the remaining particles of fly-ash before being exhausted to the atmosphere by induced-draft fans through a tall stack.

Automated continuous operation of the electrical precipitator, Opzel-type collection plates and magnetic-impulse plate rappers make the 99 per cent efficiency possible.

A resident of the French capital, Paris, breathes in oxygen mixed with pine scent at a franc-in-the-slot machine. Booths containing machines are being set up to help people cope with gases from the Paris traffic.

## Con Ed. Denied Use of Gas Fuel

A plan by the Consolidated Edison Company to reduce smoke pollution in New York by firing its boilers with natural gas bought directly from Texas producers was upset by the Supreme Court.

The plant is near the United Nations, and there have been many complaints of smoke from its smokestacks. The theory was that natural gas would produce less ash and chemical pollution than coal, the fuel now used.

According to Supreme Court Chief Justice Earl Warren, air pollution was an important consideration, but it was not shown that other methods, particularly the use of gas presently available to Consolidated Edison under other forms of service, could not be used to solve the problem.

William T. Brady, director of information, said the company had spent $100,000,000 on pollution-control and would spend about $10,000,000 this year and the same amount next year.

The company declined to say what its next legal move might be, but an official said: "We're not going to quit as long as there is an avenue open."

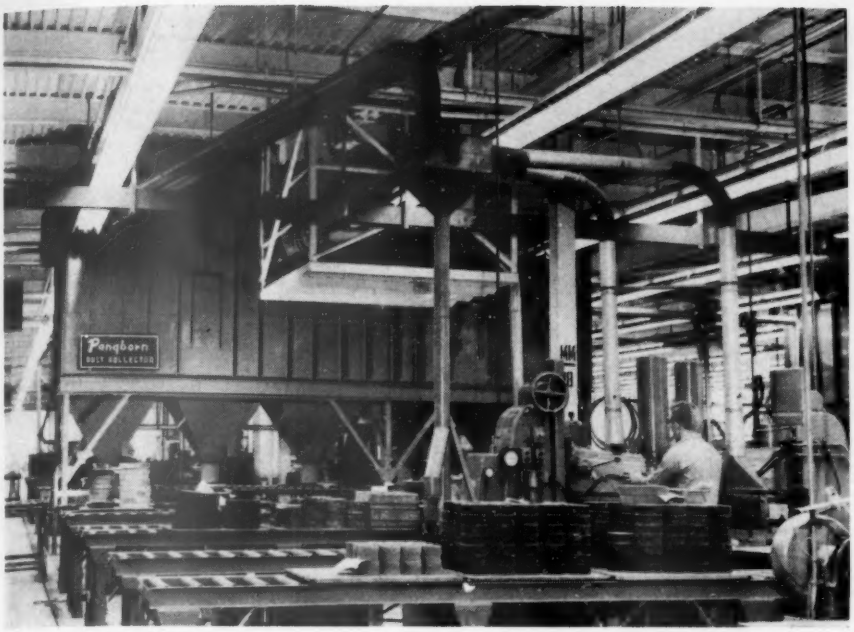
## $225,000 Is Spent To Keep Air Clean

An electrostatic precipitator, designed and built by the Metal Products Division of Koppers Company, Inc., is being installed at the Rayonier, Inc., Gray's Harbor Mill of Hoquiam, Washington, as part of a move to utilize the most advanced air pollution control equipment.

Attached to the base of the stack leading from the boiler of the new sodium base liquor recovery system, the precipitator will trap fine particles of sodium sulfite, which otherwise would be blown out the stack and over the surrounding area. When the plant is in full operation, the precipitator is expected to trap approximately 55 tons of the material in a 24-hour day.

The new recovery system at Rayonier's Gray's Harbor Division is a part of the company's current $30,000,000 expansion program. Cost of this highly efficient "dust catcher" to keep the air in the community clear and clean is approximately $225,000.

*For information on any product advertised or to comment on feature material, use the cards on page 51.*




One of the six dust collectors used at the new plant of the Norton Company to control nine tons of dust a day.

# 6 Collectors Trap 9 Tons Of Dust Each Day

Six "Self-Cleaning" Pangborn dust collectors in the wheel finishing section of a new plant of the Norton Company, makers of abrasive products, each with 3,000 sq. ft. of cloth area and exhausting 12,000 cfm collect 9 tons of dust a day. Dust collected is mostly silicon carbide and aluminum oxide. There are four Pangborn cloth screen dust collectors in the compounding and mixing departments.

Norton Company points out their newest dust control system is a balanced system: the pressure drop (maximum 2 in. wg) is figured for each dust source. Neoprene elbows are used on all piping. Hopper bottom connections match the special hoppers used for disposal, with special hoods and flexible piping to provide control of dust during the hopper unloading process.

The nine tons of wheel finishing dust collected each day is salvaged. It is not used again for the manufacture of grinding wheels but has other valuable uses.

## *Specific Data Proves Value of Cooling*

"There is now considerable data to prove the percentage increase in office and factory workers' efficiency and productivity, the speed of recovery of hospital patients, and the improvement in the learning rates of students through the use of air conditioning," stated W. J. Ortman, market sales manager, industrial buildings, Minneapolis-Honeywell Regulator Co.

Speaking before the American Gas Association's recent Gas Air Conditioning Sales School, Ortman authenticated his general statement with these examples.

A search of all published literature related to increased efficiency through air conditioning showed that reports in office buildings resulted in increases in efficiency from 20 percent to over 50 percent, and in factories from 22 percent to 28 percent.

In office buildings, reports relating to reduced absenteeism showed reduction from 27 percent to 30 percent and in 75 factories similar reductions.

A report of labor turnover indicated a reduction of 40 percent.

A survey of churches indicated improved attendance of as much as 50 percent.

The Federal government conducted a stenographic test when stenographers typing triangulation data worked two weeks in a non-air conditioned space and were then transferred to an air conditioned space. Using the same typewriters, their output increased 24 percent.

A survey of 75 manufacturing plants in the New York City area indicated that 100 days in each year are so hot or humid that employes either slow down or stop work entirely during part or all of the day, and that the employers lose an average of $108 each year for each employe working in a non-air conditioned building. Plant absenteeism dropped 25 percent to 30 percent after the installation of air conditioning, turnover in personnel was reduced, cleaning costs were lower, and productivity increased.

Expanding on the market opportunities suggested by such findings, Ortman stressed that "Too often, in the design of a modern building, major attention is given to visual environment and too little attention is given to the other elements of the total indoor environment with the result that the mechanical and electrical facilities often cost more and are sometimes less efficient.

"It is in this area that we have the greatest opportunities to reduce the cost of today's buildings. . . . Then we can move in with a legitimate presentation on thermal environment — year-round air conditioning," he concluded.

## *To Hold Industrial Hygiene Conference*

A joint meeting of the Western Michigan, Detroit and the Northeastern Section of the Industrial Hygiene Association will be held May 24, 1961 in Midland, Michigan.

The all-day program will begin at 9:30 A.M. with scientific papers and will end with a question and answer session starting at 3:30

*(Please turn to following page)*

# NEWS of the Industry . . .

*(Continued from preceding page)*

**Hygiene Conference**

P.M. Tentatively the papers will include discussions of: carcinogensis; applications of toxicological data; paints; polyurethanes; new processes in foundries; and calibration of air metering equipment.

For more information on the conference, contact Mr. D. Fowler, Chief Industrial Hygienist, Chrysler Corp., 341 Massachusetts Ave., Detroit 31, Michigan.

## *Ask $32 Million for Pollution Control*

An advisory committee to the Surgeon General of the Public Health Service has called for a threefold increase in the Nation's research effort to control the growing menace of air pollution.

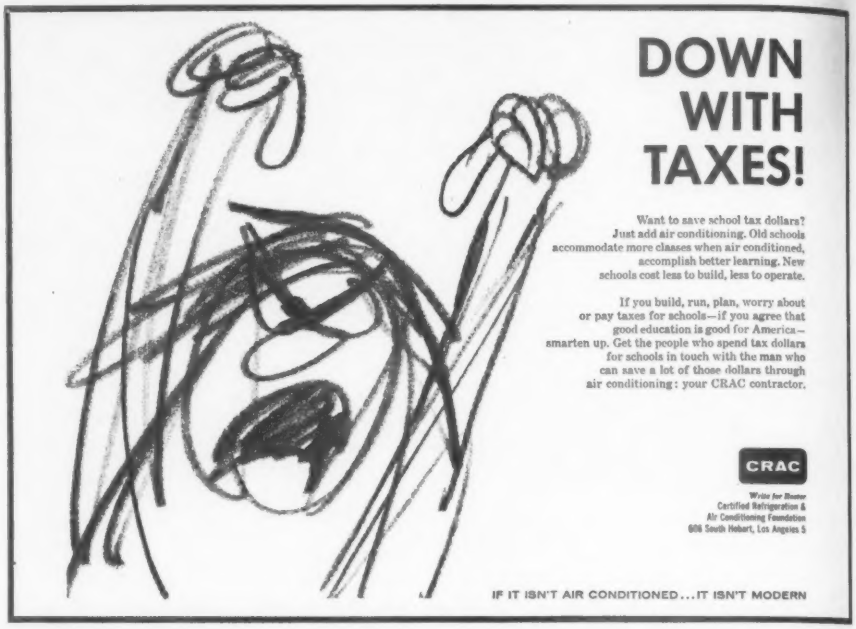
The committee recommended that financial support of air pollution research be increased from a current estimated level of $11 million annnually to about $32 million a year by 1968. The ten man committee further recommended that the Federal Government assume 40 percent of this cost, industry 28 percent and State and local governments 32 percent.

## *L. A. Or Detroit Is The Cleanest City?*

The December issue of the Los Angeles County Air Pollution Control District Report alleges that Los Angeles air is the cleanest of the four largest U. S. Industrial communities.

Not so — says Morton Sterling head of the Detroit Air Pollution Control Office. Los Angeles measured only one index and there are considerable differences in measuring techniques. The University of Toronto has conclusively shown that the dust collection device used in Detroit collects at least twice as much as does any other device in use. Even with this more efficient device, the City of Detroit showed only 36.2 tons per square mile per month average for 1959.

Below: Cartoon with shock headline, being used by the CRAC in their school air conditioning drive.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IF IT ISN'T AIR CONDITIONED...IT ISN'T MODERN

# CRAC Pushes Drive for School Air Conditioning

Members of the Refrigeration & Air Conditioning Contractors Association of Southern California firmly believed that there are many good reasons for air conditioning schools the year round, so they are now engaged in an active campaign to educate the citizens of this area in general, and school boards and other influences in school construction in particular, on the advantages of air conditioning.

Through the medium of its CRAC (Certified Refrigeration & Air Conditioning Foundation) advertising program, the RACCA group has inaugurated a program aimed at startling those concerned with school construction into giving some consideration to the possibilities of air conditioning schools for year-round operation.

Also being developed are plans for personal presentations to school boards and to architects and consulting engineers who are specialists in school work.

A RACCA of Southern California committee concerned with the program for promoting school air conditioning, met recently with Maurice Wilson of Carrier Corp., who has made an intensive study of the current status and future prospects in school air conditioning.

A principal piece of advice offered by Wilson was to concentrate on the secondary school.

"Authorities at the college level are generally convinced of the importance of air conditioning in their planning for providing facilities for expanded enrollments," Wilson says.

"But at the secondary school level a big job needs to be done to convince all influential elements that air conditioning can do what we think we can prove—improve the students' 'take-home' knowledge because of improved conditions for learning—and at lower costs."

It seems to be the belief of those who have studied the situation that while school officials and some architects and consulting engineers are convinced that air conditioning is very much worth while, that such important influences will not take the lead in espousing any change from the "traditional" types of school construction, and heating and ventilating methods

# NEXT MONTH

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- **SHIP'N SHORE GETS MORE WITH AIR CONDITIONING**
  (Case history study of what happens when women's blouse manufacturer installs air conditioning. Efficiency goes up 10%, absenteeism, formerly a problem, is virtually eliminated, production goes up a whopping 50%. By E. A. Sloane.)

- **CLEAN AIR CUTS REWORK FROM 1200% TO 20%**
  (Gyros had to be reworked several times, due to dust in their "innards," hence the 1200% reject rate. By W. R. Jerome, of North American Aviation's Autonetics Div., article discusses air handling, air filtration and clean room set up in general for final gyro assembly.)

- **BAGHOUSE SOLVES AIR CLEANING PROBLEM AT BETHLEHEM STEEL**
  (by Harold Schubert, plant engineer, article describes unique application of glass fiberglas bag filter media for collection of particulates from two new 100-ton electric arc furnaces.)

- **DUST-FREE METHODS OF FILLING OPEN TOP BAGS**
  (by William V. Andresen, chief industrial hygienist, American Cyanamid. Data on hood design, ventilation requirements, for dust control during valve type bag filling.

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## Industrial Hygiene News

### Rocket Propellants

At the 25th Annual Meeting of Industrial Hygiene Foundation in Pittsburgh during October, 1960, Mr. H. M. Brown, Reaction Motors Division, Thiokol Chemical Corp., Denville, New Jersey, presented the Safety And Industrial Health Aspects Of Rocket Propellants.

Mr. Bowman states, "Any discussion of the subject of safety and industrial health aspects of rocket propellants will of necessity include the discipline of the rather general topic, laboratory safety, which incorporates first air, fire prevention, safety equipment, accident prevention, ventilation, safety instruction, proper safety attire, and safety-conscious department."

"In the field of Rocket Propellant research and development laboratory personnel are exposed to virtually all of the hazards normally encountered in chemical laboratories plus many more because of the nature of the research products being sought, namely, high energy fuels, oxidizers, monopropellants and propellant combinations. . . . Consequently, unless there is an active safety indoctrination program by which the potential hazards are made known to everyone and through which safe practices are established and monitored, destruction of life, limb, equipment, and/or facilities may be the major end item of propellent research and development. . . ."

"Starting at the laboratory level of operation let us examine some of the safety and industrial health problems that must be considered. Perhaps the first consideration should be that of maintaining an acceptably low level of air contamination both in the laboratories and in the surrounding facilities and community. One of the properties of many of the chemicals used in propellant research is that of being highly toxic. Recommended threshold limit values have been published by the American Conference of Governmental Industrial Hygienists.

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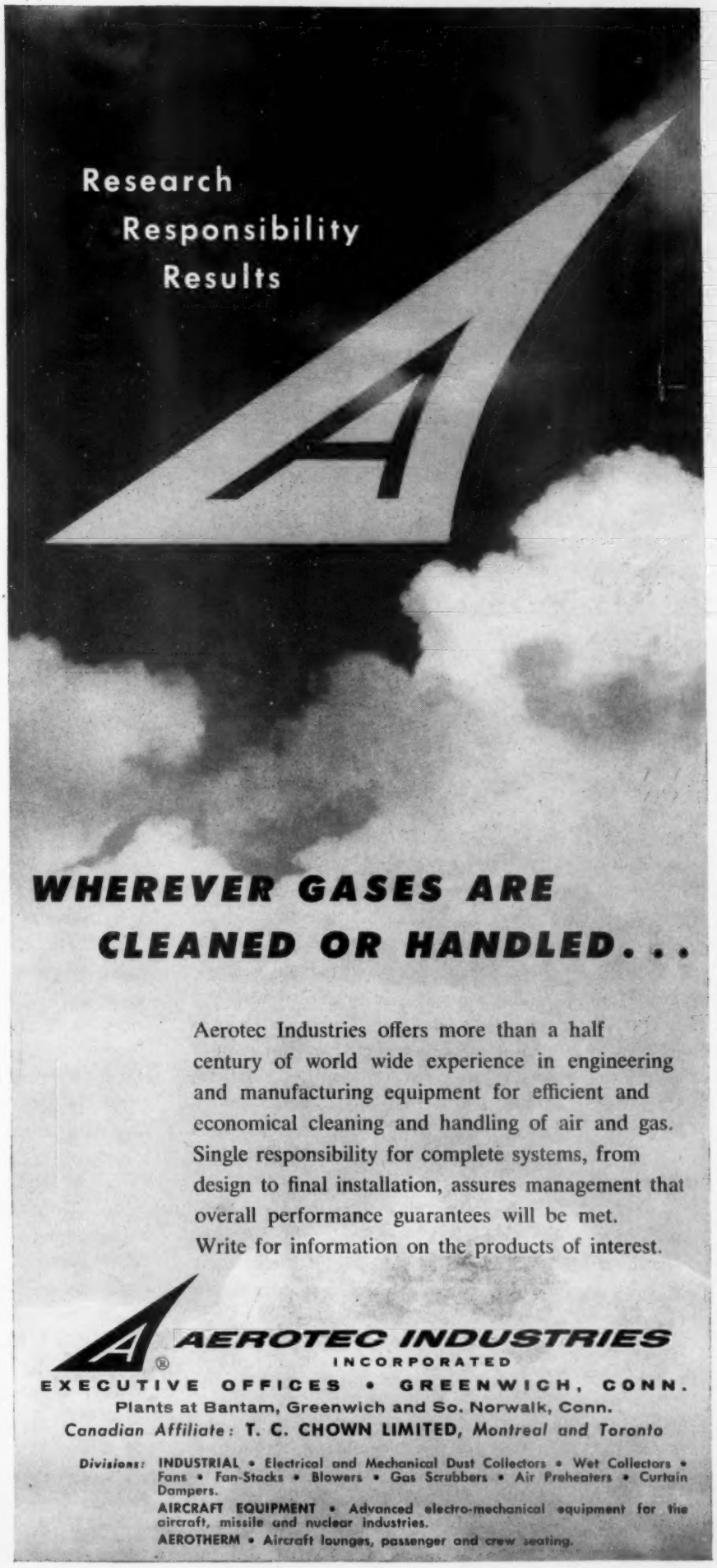
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# *Super Clean Air For* **Super-Clean** *Klystrons*

Klystron tubes for radar have "innards" requiring critically close tolerances in assembly. "White Rooms" for their assembly pay for themselves in assuring quality in the field. Article discusses design and operation of super-clean area for Litton Industries' klystrons.

by G. V. Freeman
*Plant Engineer*
*Litton Industries*
*Electron Tube Div.*

AT THE SAN CARLOS PLANT of Litton Industries we are engaged in the manufacture of microwave tubes. These vary in size from eleven-foot klystrons to small magnetrons whose "body size" is about one-half inch in diameter and one inch in length. These small magnetrons require a white room for assembly, because within the envelope there is a very small cathode and heater assembly and a system of strapped radial vanes, clearances between which are extremely critical. Mechanical tolerances are within one ten-thousandth of an inch. Chemical purity is also essential in order to obtain the high degree of vacuum required.

Any dust or foreign matter will cause the tube to malfunction. Unfortunately, this does not show up immediately after the tube is manufactured but may seriously curtail the life of the tube. For a particular tube we have a product specification that guarantees the customer 5,000 hours of life.

In planning our white room we first considered the following items:

- Degree of cleanliness required.
- Minimum acceptable room size.
- Possible division of process flow into various areas of cleanliness.
- Balance of cost considerations and operational requirements.
- Selection of the site.

After discussion with technical and supervisory personnel, we decided that the manufacturing process could be divided into two sections; first, actual assembly operations in which the cathode, vanes, strips, etc. are assembled by hand; second, processing such as heat treatment, brazing, chemical cleaning and welding operations. This divided the area into a ratio of approximately 2 to 3. It was necessary to have the cleanest area for the assembly operations so it was decided that we would supply this with the cleanest air possible and then allow the air to escape into the processing room. This arrangement has worked very well.

The room size was governed by the space that was available and for the whole complex, which happened to be 22 ft. by 40 ft. with a space between the rafters of a nearby attic in which we were able to build a room for the air conditioning and cleaning.

There were severe limitations on the site as the room had to be built inside an existing building which had a concrete slab floor and a 14 ft. ceiling. There was no easy way of bringing in power or providing for drainage.

Other points that received due consideration were "changing rooms" for male and female workers who would be using the room, an air shower and means whereby the occupants might leave the room quickly in event of emergency.

Because equipment associated with tube manufacture comprises many elements such as furnaces, pumps and chemical apparatus that in themselves produce oil fumes, scale and metal particles, it was decided that as many of these units as possible would be located next to the room, and only functional process equipment would open into the room. This worked into an admirable arrangement in removing this source of contaminants; in allowing 95 percent of the maintenance and servicing from outside the room; in reducing the air conditioning load; and in maintaining a relative humidity of under 40 percent.

A further problem that we had to contend with was that production schedules and commitments for the products to be produced in the area allowed only six weeks for erection. We did not quite meet this requirement, due in part to late delivery of some critical items, even though prefabrication of several items commenced several weeks in advance.

## White Room Specifications

The general requirements evolved as follows:

- A total floor area of 800 sq. ft.
- A maximum height of 10 ft.
- An area divided into a "super clean" room, a clean room, two changing rooms, and an air shower.
- A minimum of 20 changes of air per hour with 50 percent recirculation.
- An area to be pressurized to at least 0.2 inches of water column above the pressurized outer room.
- The degree of cleanliness as high as possible at the assembly bench level.

We started the project by first building a floor-to-ceiling screen of two by sixes and "Mylar" sheet around the area, to shield it from the production processes that had to be continued in the surrounding room. This was followed by stripping out all the services and benches, etc. that occupied the site.

The sub-floor was laid out in the area by first laying out 2 in. x 12 in. joists with stringers. Between these the floor drain water services and some electrical supplies (that could not otherwise be brought to the center wall) were laid in place. Over this was laid the floor which consisted of one-inch waterproof plywood.

Around this area we set up a series of 2 in. x 4 in. aluminum channels on end with base plates and gussets. These were spaced on six ft. centers and were eleven ft. high. They were secured to the concrete slab and constituted the uprights for carrying the walls and roof. There was an exception where the air shower was placed. Here we used 4 in. channels to form a rectangular box. The grid for sucking out the air for the shower together with its ductwork was placed in position at this time.

Next we covered the floor area with Armstrong's "Corlon" in 6-ft. widths arranged so that the seams would come beneath the dividing walls. This was first laid on the site and allowed to flatten out for a couple of days before gluing down. Previous experience with this material had shown that in long lengths there was considerable shrinkage between the time it was unwound from the coil until it was laid.

The uprights were then tied together with 2 in. angle. At this time, we had a floor and a "forest" of uprights.

The wall sections came next. We had decided on Formica – faced ¾ in. particle board panels set in aluminum angle. Aluminum is the least harmful metal oxide in the manufacture of thermonic tubes.

A point worth mentioning here is that we used colored Formica in the various rooms. White was used in the changing rooms only as this would

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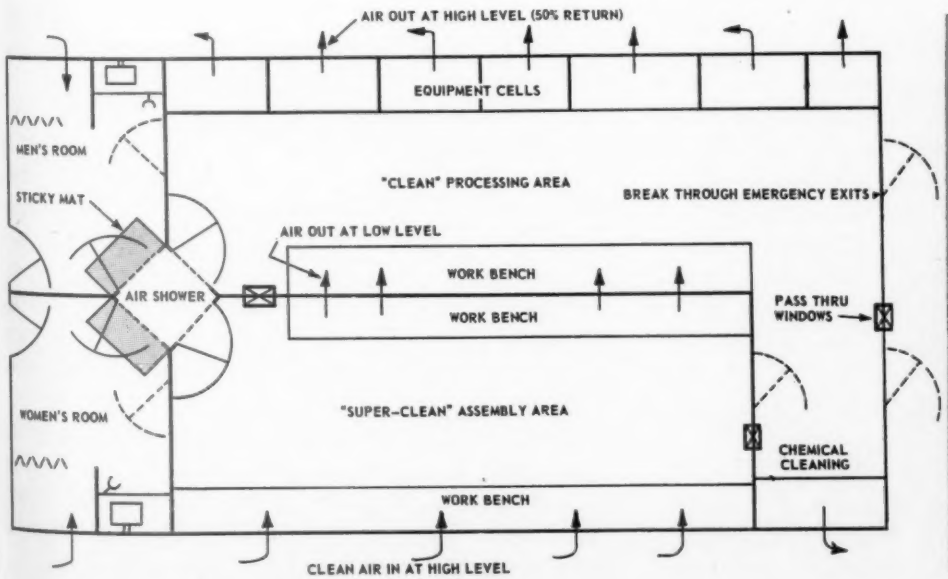


**Fig. 1: Left, floor plan layout of super-clean rooms at Litton Industries. Note entrance set-up at left, including separate men's and women's entrances, use of sticky mats, the air shower set-up, and air distribution to room.**

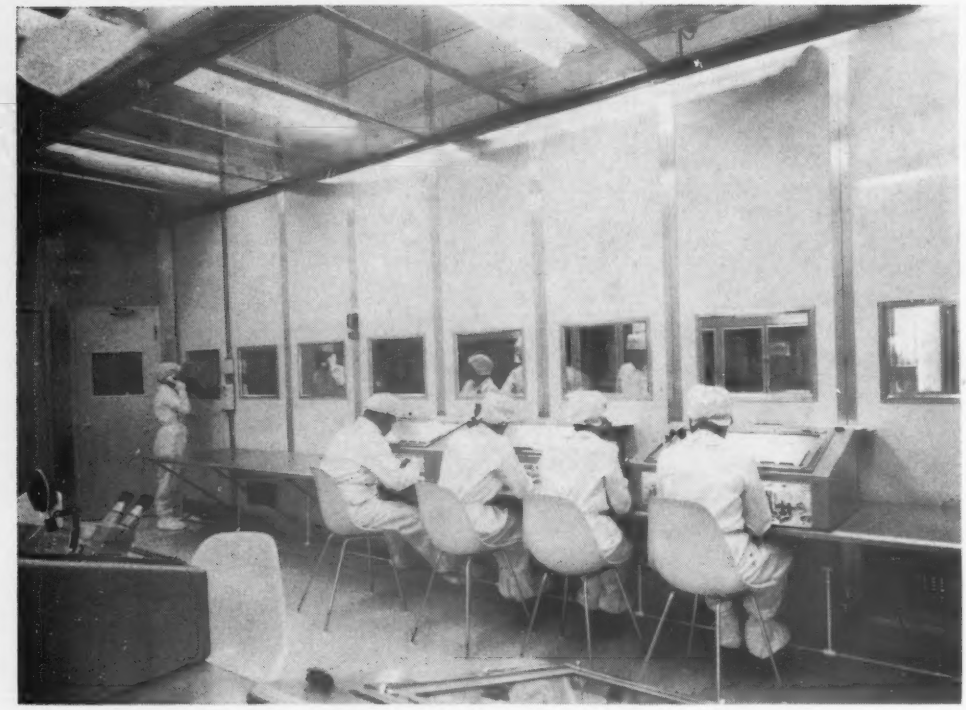

Fig. 2: Part of "White Room" at Litton. Note special Dacron lint-free clothing, including booties. Walls are faced with Formica, ceiling is ¼-inch wired glass at 10-ft. level.

*(Continued from preceding page)*

naturally create too much eye strain when used in assembly areas. Pale blue was used in the assembly area and green for the processing room. In these walls we placed aluminum framed windows with neoprene gaskets holding one-quarter inch wired glass. We also used very thin neoprene as a seal between all the walls, floor and ceiling joints.

Actually, the walls took longer to erect than was estimated and this, I think was due to the mechanics being a little uncertain at the start. If we do it again, we will most certainly make some minor changes in order to speed this up.

## Ceiling Construction

The ¼ in. wired-glass ceiling was next put in place at the ten-foot level. The fixtures to illuminate the room were suspended from Unistrut anchored to the ceiling. This arrangement enables us to move the fixtures into various positions in order to give the desired light distribution. The decision to have the lighting of the room from an outside source was, I feel, a good one. Lamps and fittings are always a problem in an assembly area as they need frequent replacement and, worse still, attract dust, etc. by a static charge which fall when the lamp is turned off.

The ceiling structure was made of heavy aluminum channel construction 5 ft. O.C. running the length of the room. The quarter-inch wired plate glass was set in aluminum angle frames matched drilled for ease of fastening one frame to another.

The 4 in. x 6 in. aluminum channels were supported by tie rods from the 14 ft. ceiling to the level of the clean room ceiling. The aluminum channel also supported the sprinkler system piping.

The air shower consists of four aluminum doors and frames supported from aluminum angle uprights. Incidentally, the two doors opening into the assembly and processing areas had windows and all doors opening outward from the interior of the air shower. The floor of this chamber consists of a circular exhaust grid upon which the operator stands. This grid is over an exhaust duct leading to a 1600 cfm exhaust fan located in the attic. A built-in duct is created by having a strip of metal about eight inches wide built across the aluminum angle upright on which were mounted twelve aircraft type air nozzles. The ducts are supplied from a flexible trunk blower which delivers 1250 cfm. Another blower supplies an additional 250 cfm to a diffuser set in the air shower ceiling approximately 7 ft. above the exhaust grill.

The air entering the blowers is cleaned by submicron filters. This operation does not rob our air conditioning but comes from the filtered outer room.

On entering the air shower an illuminated button is pressed that locks all doors and operates both the air supply and exhaust blowers. Indicator lights show when it is in use. A time delay relay controls the air flow, and we have found that a very good cleaning job can be done in about 12 seconds. We were concerned at first that the volume of air passing over the operator would be so great as to cause discomfort. However, this has proved not to be the case.

The operator changing rooms were next to be considered. It was impossible to provide toilet facilities and in many respects this is very desirable. Two small rooms, one each for men and women, have a curtained cubicle for changing outer clothes, a stain-

less steel sink with a knee-operated water supply, and an electric hand dryer. All valves, traps, etc. are underneath the sink and are accessible from outside the room only.

Equipment in the assembly side consists of two wall mounted aluminum benches running almost the full length of each side of the room. After a few days' operation it was found necessary to provide foot rests which were added to the bench supports.

The assembly cabinets are mounted on these benches. It is in these that the critical body work is done. (These cabinets are fitted with absolute filters at 2 microns.) On the working face of the cabinets we have mounted binocular microscopes. Personnel sit on chairs of pressed fiberglas with legs of aluminum tubing.

Pass-through windows are sometimes difficult things to design and maintain. They involve double doors, microswitches and interlocks, all of which give maintenance problems and are themselves a source of metallic particles. Our approach was to build two aluminum disks about 16 inches in diameter, having a circular groove about one-quarter inch wide near the outer rim. These disks were mounted in a frame at 90° to the plane and about 20 in. apart. The lower half of these frames was sealed by a small flat tray. Into the grooves we have a Lucite shield bent into a radius to fit the grooves and covering about a 210° arc. To operate the window the operator lifts one side of the Lucite cover and places the work upon the tray. When lifting the cover it naturally slides back and completely covers the other side (receiving). Of course the reverse happens on the opposite room. In this way the problems of two doors being opened at the same time is eliminated.

## White Room Equipment

A great deal of design went into the equipment used in the processing room. This is highly specialized and consists of RF bombers, hydrogen furnaces, vacuum furnaces, micro-machining operations and chemical cleaning. These were designed as separate units built off the site and arranged so that they can be slid into position and sealed to form an integral part of the wall.

As mentioned before only the actual parts necessary to the process are facing the room. All the ancillary equipment such as vapor pumps, switches, controls, etc. are outside the "wall" and operated by a series of illuminated press buttons from inside. The buttons themselves are sealed behind polyurethane covers. As a considerable amount of hydrogen is used in the processing, special arrangements were made for exhausting. Wired glass doors provide access to the process equipment.

The vacuum furnace is arranged so that the only parts exposed to the room are a door similar to a miniature bank vault and a few press buttons. The furnace can be serviced, cleaned, etc. from the rear by removing an end plate. The mechanical vacuum pumps, ion-pumps, Cal-rod heaters and heat shields, etc. are all outside the room.

Cleaning of the room is done by the working personnel, using a vacuum cleaning system with outlets in the walls. It operates on a 24-volt system with the motor and container located in a nearby courtyard.

Clothing for those working in the room consists of 100 percent Dacron Polyester one-piece suits with head caps. Shoes are taken off outside the changing rooms and "sneakers" are put on. Nylon overshoes and gloves complete the uniform. There are sticky mats located outside the entrance to the shower.

## Operating Notes

Now for a few notes on the operation. The air is changed 20 times per hour. Approximately fifty per cent of the air is recirculated. The remainder is taken off by small exhaust fans located over the various pieces of equipment. The air conditioning equipment is capable of 4,000 cfm. The heating is provided by a boiler rated at 132,000 btu and the system arranged to provide a relative humidity under 40 percent. The main air cleaner for the building complex is an electrostatic precipitator at 24,000 cfm, with a 4,000 cfm smaller unit in front of the air conditioner.

The main sub-micron filter has a capacity of 4,000 cfm. We have pressure indicators across the filters to check the pressure drop.

*(Please turn to page 40)*

**Fig. 3: Another section of Litton super-clean facilities for Klystron tube assembly. Note that RF bombers, hydrogen furnaces, vacuum furnaces, etc., can be operated from inside room, although located outside.**

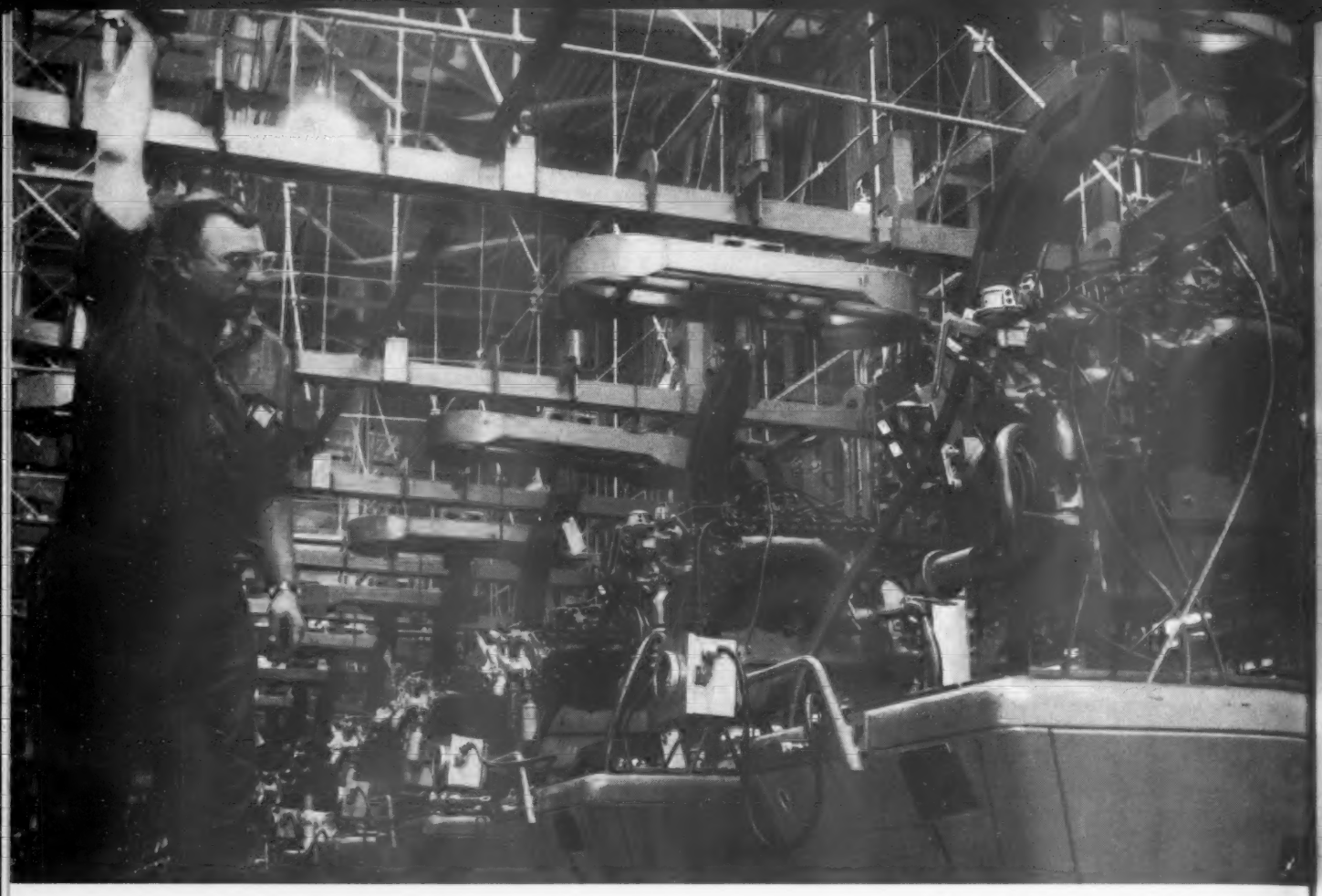

*Fig. 1:* "Hot test stands" above are used to check out Ford auto engines, make final adjustments.

# *How Safe Is Your Industrial Ventilation?*

Installation and application details on exhaust systems, make-air systems, industrial heating systems are considered in the light of Ford standards.

by **E. M. Schmidt**
***Chief mechanical engineer,***
***Engineering and Construction Dep't,***
***Plant Engineering, Mfg. Staff***
***Ford Motor Company***

INDUSTRIAL VENTILATION may be either dilution ventilation or comfort ventilation. Dilution ventilation, as the name implies, refers to the dilution of contaminated air with uncontaminated air in a general area, room, or building for health hazard or nuisance control.

The purpose of comfort ventilation, on the other hand, is not to keep personnel comfortable in the ordinary sense but to actually prevent acute discomfort or physiologic damage from abnormal atmospheres. Since the equipment used for either application is practically identical, no distinction will be made as to its use. Process exhaust usually directly connected to its cause is a highly specialized field and will not be discussed other than in occasional references.

The safety aspect of industrial-ventilation equipment is many-pronged. It has to be safe as far as the operating and maintaining personnel is concerned. It has to be safe for the employees for whose benefit the system was installed. It has to be safe for the process that may have caused its installation. It has to be safe from self-destruction.

Exhaust systems, air make-up systems, and industrial-heating systems will be considered and

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covered separately as to their purpose, function, and the safety considerations in their design, installation, and operation.

### Exhaust Systems

The exhaust of air out of an industrial facility constitutes the base, the starting point, upon which industrial ventilation is built.

Every industrial automotive plant has some inherent process in its operation that requires exhaust to discharge air to the outside of the building usually after some cleansing operation. The air that is blown out of the building came from the immediate area around the process installation. The replacement air may come from open windows and doors in the summertime, from some other part of the building, or by robbing some other less powerful, exhaust system of its share of air. If it comes from some other part of the building it may bring along contaminants and drag them past personnel and other processes on the way. Winter compensation for closed windows and doors, seasonal and part-time operations, and temporary processes which may be eliminated must all be considered.

### Design Criteria

At the author's company after considering air changes, breathing zones, air-movement zones, and dead-air zones, a fairly simple design criterion was established for ventilating industrial facilities. It is based on exhaust and requires: (*a*) 2 cfm per gross ft. of floor area during the ventilating season for medium-discomfort type of plants such as assembly, light fabricating, and warehousing; (*b*) 3 cfm per gross sq. ft. for heavy-discomfort type of plants such as engine plants, transmission plants, stamping plants, heavy fabricating, general areas of foundries and glass plants, and paint and bake areas. Special areas in foundries, glass plants, die-casting and heat-treat areas get special treatment, of course.

During the heating season, this exhaust is reduced to ½ and 1 cfm per gross sq. ft. respectively, or to the amount of the process exhaust, whichever is greater. The total cubic footage of air to be exhausted is reduced by the amount of permanent, year-round process exhaust and by a credit for open windows equal to the area of the bay adjacent to the perimeter walls with windows, times the number of cfm per sq. ft.

The balance is exhausted by comparatively cheap roof-mounted propeller exhaust fans, Fig. 3, of 20,000-cfm capacity each on a 2-cfm-per-sq.-ft. design and 30,000 cfm capacity each on a 3-cfm-per-sq.-ft. design. These are of simple construction—an electric motor, a propeller, and a sheet-metal housing with gravity dampers to keep the rain out when the fan is not operating. A three-page company "Standard" on this piece of air-handling equipment establishes a quality base and the safety aspects. The standard will be considered in detail in the section on equipment.

### Safety Requirements

The safety requirements and other additional quality-control features do not run the cost up on these units. Although they are known as the Ford Standard roof

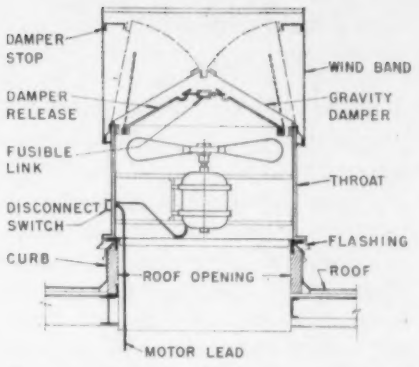


*Fig. 3:* Ford's standard design of roof mounted propeller exhaust unit is shown above.

exhausters in the ventilation industry, the cost is less today than it was several years ago for a lot less desirable piece of equipment.

The other exhaust systems used for industrial ventilation, such as duct work with vane-axial or centrifugal exhaust fans, are identical to the equipment used for air supply and will be covered there.

### Air-Make-Up Systems

Air-make-up systems, as the name implies, replenish the air removed by exhaust systems, process, or ventilation. Air make-up in its simplest form may be opening a window to allow drawing of air to an area with a negative pressure condition. In its most extensive form, air make-up may be a system consisting of air-intake louvers, automatic dampers, filters, a controlled air-heating medium, fan, duct work, and diffusers. The point of application of make-up air is of prime importance.

The most successful installations have been the ones that supply air

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*Fig. 2:* Huge Rouge plant of Ford Motor Company is shown in this aerial view.

# Industrial Ventilation

*(Continued from preceding page)*

directly to or at the point of exhaust. This minimizes drafts and the possibilities of additional contamination and usually results in a saving of equipment capacity. However, a directly applied air-make-up system can only be justified where the exhaust is localized and extensive, or where the area air has been conditioned and is too expensive to throw away, or where it is required by code.

Normally, in ventilating an industrial area, good results may be obtained by literally "dumping" make-up air into the building at strategic spots and allowing it to find its way to the negative-pressure areas created by exhaust systems.

### Roof Exhausters

When exhaust units are located on the roof and make-up air is supplied above the truss line, it will not benefit the employees. It is either short circuited directly to the exhaust fans or else it is shot down through and mingles with layers of hot, contaminated air before it reaches the occupant zone. At the author's company, the air is introduced at a 10-ft. level with a specially designed annular ring column diffuser, Fig. 4. The drum louvers incorporated into the diffuser allow extreme flexibility in the disbursement of the air, up, down, left, right, straight, or any combination of these movements.

The diffuser may be supplied through duct work by a central-fan system, individually packaged fan-coil sets, indirectly fired industrial gas and/or oil heaters, or direct-fired industrial gas heaters.

At this point the difference between an air-make-up system and a heating system becomes slightly vague and both systems will be covered. During the heating season an air-make-up system must temper the air it discharges to at least the maintained temperature of the area it serves, making it relatively simple to provide additional heat to the air to counteract heat loss through walls and roof of the facility. Economics enter into the picture since heating of outside air is expensive. At the author's company, the wall and roof heat losses of the adjacent bay are counteracted by inexpensive, 100 percent recirculating, vertical-throw perimeter unit heaters. The make-up air units are then designed to pick up the roof losses only.

### Central Fan Make-Up

A central-fan air-make-up system, consisting of air-intake louvers, automatic dampers, filters, steam coils, centrifugal or vane-axial fan, duct work, and suitable diffusers, is by its very nature a fairly safe installation, particularly if quality products from reputable manufacturers are specified.

However, even these can be improved. For years an automatic oil bath filter was used for cleaning the air in a central-fan system. This required an oil clarifier, emergency drains, fire protection, and systematic desludging of the sump. The unavoidable spillage, leaks, and carryover spread an oily film over the immediate area around the filter with its ever-present danger of fire. Recently the automatic roll-up type of filter with a fiberglas mat has been used almost exclusively. This installation, not using oil, eliminates the need for a clarifier system, drains, and fire protection and requires little maintenance other than replacement of the filter media.

### Steam Coil Freeze Protection

Steam coils must be protected from freezing in order to prevent coil damage and possible injury to personnel and other equipment. Steam-distributing coils, freeze-up controls, and proper venting and trapping can prevent many of these problems. Fans, either vane-axial or centrifugal, can be made safe by specifying operation within accepted outlet velocities. Screens on the inlet side of the fans should be provided when they are operating in or drawing out of a plenum. An overheat device incorporated in the system can be connected to stop the fan and ring an alarm in case of a dangerous temperature increase.

Fan-coil units are actually packaged small-scale central-fan systems of limited air-handling capacity. The basic unit consists of a fan and a coil. Dampers, filters, additional coils, duct work, and diffusers may be added to suit the application. The same precautions apply as in the case of the central-fan system. Adequate coil specifications, fan-speed limitations, and accessibility requirements will insure a unit that is safe.

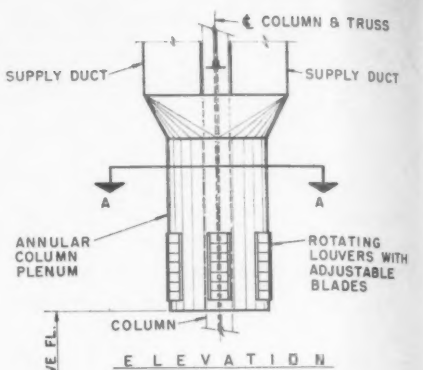


*Fig. 4:* Column diffuser unit used for supply air systems.

Quite often, economics dictates the use of indirect oil and/or gas-fied industrial heaters. In principle these units are similar to the fan-coil units except that the heating

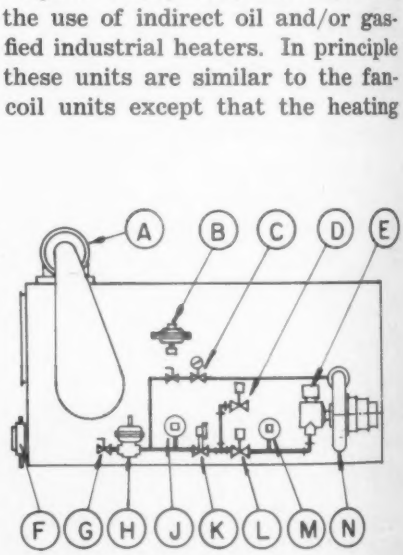


*Fig. 5:* (A) Fan motor; (B) Airflow switch; (C) Pilot solenoid valve; (D) N.O. Solenoid valve; (E) Temperature control motor; (F) Temperature controller; (G) Main gas cock; (H) Gas regulator; (J) Low pressure switch; (K) Safety shut-off valve; (L) N.C. solenoid valve; (M) Hi-pressure switch; (N) Maxon airflo mixer.

medium is a primary and a secondary heat exchanger. Combustion of the fuel and the high temperature of the products of combustion provide heat to the air passing over and around the heat exchanger. There is no intermingling of the products of combustion with the air.

How do you safeguard a potential bomb such as this? Listing by the Underwriters' Laboratories, Inc., and approval by the American Gas Association are a good start. Requesting a 10-year warranty on the parts that are in direct contact with the flame and/or flue gases helps to get material best suited for the application. Flame testing by the manufacturer before shipment eliminates a lot of field problems. An induced-draft fan insures positive purging and elimination of the products of combustion.

### Control Installation

Proper controls and proper installation of controls are of prime importance on this unit. The controls must meet the most recent recommendations of the Factory Insurance Association; see Fig. 5. These consist basically of purging, flame-proofing of the pilot and main flame, proof of air-fan and combustion-blower operation, high and low-gas-pressure switches, high-temperature cutouts, and proper venting on shutdown of the unit.

In spite of all attempts to provide a safe unit, one serious accident resulted when a puff from incomplete combustion threw a relief door open. The piping to the gas pilot had been piped across the path of the door swing and was broken off. The resultant flame seriously burned an employee working on the unit. Field installation of the unit is of prime importance.

In recent years pressure has been brought to bear on industry to install direct-fired air heaters in industrial plants. Direct-fired heaters are units in which the ventilating air is blown or drawn through the flames and, together with the products of combustion, is introduced in the area to be heated. The main arguments for the use of direct-fired units are less first cost, infinite degree of flame control, lighter weight, and higher efficiency of heat exchange.

The main arguments against the use of these units are the fact that the products of combustion are introduced into the breathing area; that, in case of control failure, raw gas may be blown into this same occupied area; and that recirculation of area air is neither safe nor practical.

### Direct-Fired Units

It is apparent from an economical standpoint that the use of direct-fired make-up-air units must be considered. In order to safeguard personnel and property, certain precautionary measures will have to be built into the units and into the installation. On this basis it is imperative that each installation be evaluated on its own merits by competent engineering personnel.

The design of industrial ventilation must be approached with an open, practical mind. The heated contaminated air rises to the underside of the roof; therefore that is the place to install the exhaust facilities. The comparatively cooler and cleaner outside air for make-up is most effective when introduced at a low level with sufficient control to benefit employees. Tight intelligent specifications, products by reputable manufacturers, and good field inspection during installation are prime requisites for a safe installation of industrial ventilation. Experience has proved that, within reasonable and practical limits, a safe installation is also a good installation and need cost no more than a haphazard one. The Lorain Assembly, Lima Engine, and Sharonville Transmission Plants of the Ford Motor Company are considered by the author to be prime examples of exceptionally well-ventilated industrial plants. In these plants the design, equipment, and installation are operational proof that industrial ventilation can be truly effective, safe, and still within project appropriations.

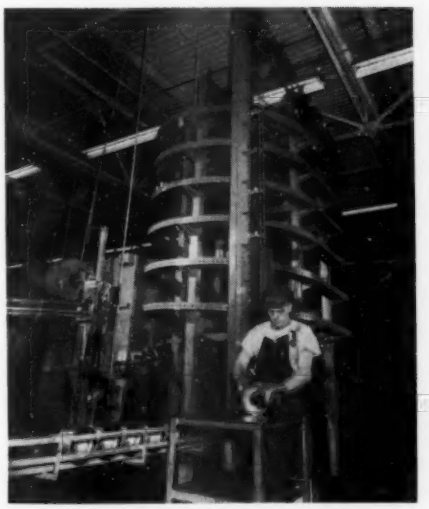

*Fig. 6:* Brake drum rolls are deburred with wire brush before dispatching to top of automated storage conveyor behind operator.

### Ford Standards

The standards established for two of the units described in this paper are of interest. Some of the provisions for the Ford Standard roof exhausters are:

1. Throat and curb assembly shall be a one-piece spinning or a continuously welded assembly — this is to eliminate the leaking experience with spot welding and bolting, and the looseness that has resulted from vibration and down thrust.

2. The gravity dampers shall be constructed of galvanized sheet steel. The damper axle-shaft shall extend the full width of damper and be securely fastened by rolling and/or riveting. The shaft bearing shall be Oilite, nylon, or Teflon. Dampers shall be spring or counterweight loaded with a 165-degree fusible-link release to open in case of fire. Aluminum dampers will not be accepted.

All of these provisions pertain to safety. Aluminum dampers have fatigued and cracked, dropping into the propeller. Stub shafts have broken or torn out of their skimpy mountings. Cheap metal-to-metal bearings have cut the axle shafts. Fusible release loading of the dampers allows the throat area to be used in smoke-vent area requirements.

3. The propeller shall be a one-piece aluminum casting of a die-formed sheet-steel assembly of

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## Industrial Ventilation

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continuously welded or riveted construction mounted directly on the motor shaft. Propeller tip speed shall be no greater than 10,000 fpm at full load rpm of the motor. Aluminum castings for propellers shall have the following minimum characteristics: 20,000-psi utimate strength, 15,000-psi yield point, 2 percent elongation. Propellers shall be statically and dynamically balanced.

Multipiece adjustable-pitch aluminum propellers have loosened, cracked, and broken. With the propeller mounted directly on the motor shaft, belts can't loosen and fly off or break. No one has to climb on the roof to adjust them. The tip-speed limitation allows the use of standard motors while keeping the speed well below the dangerous range and within acceptable noise limits. A balanced propeller adds life to itself and the whole assembly by keeping vibration to a minimum.

4. Access to and removal of the motor and propeller shall be from the roof to prevent under-the-roof maintenance with its inherent dangers to maintaining and operating personnel.

5. Each unit shall be equipped with a separate non-fused normal-duty disconnect switch in NEMA No. 3 enclosure mounted on the outside of the throat or on a bracket attached to the base. The motor shall be a totally enclosed air-over-motor type with heavy-duty sealed Life-Time bearings containing a suitable lubricant for continuous service and temperatures up to 150°F. The motor shall be securely bolted to its mounting using lock-washers, locking nuts, or castellated nuts and cotter keys. The bolts shall be the largest diameter that can be used with the holes in the frame feet. In case these holes are slotted, elongated, or out-of-round, the motor feet shall be doweled in at least two places on a diagonal.

A disconnect switch at the unit insures that no one will start it from below while someone is working on the unit. The motor and Life-Time bearings minimize required maintenance. The secure mounting of the motor prevents shifting with resultant propeller damage.

# *Tips On Direct-Fired Make-up Air Installation . . .*

After extensive research, it was decided to pattern any possible future installations of direct-fired make-up-air units after a bulletin issued by the Department of Buildings and Safety Engineering, City of Detroit, dated March 16, 1959. The recent date denotes the currency of the problem. This bulletin has the concurrence and approval of the Bureaus of Safety Engineering and Industrial Hygiene and the Department of Health. The gist of the bulletin is as follows:

1. The equipment may be used only to correct a negative pressure condition within a building where exhaust fans are in operation—this eliminates any haphazard use of the direct-fired units for miscellaneous heating of occupied areas;

2. The total discharge of the equipment shall not exceed 110 percent of the capacity of the exhaust system in conjunction with which it is used—this limit is considered practical within the limitation of equipment availability. Infiltration of industrial buildings decreases this percentage substantially.

3. The equipment may be installed only in buildings classified as industrial occupancies and each such unit shall have a discharge capacity of not less than 10,000 cfm—this controls the application of the units and establishes capacity to insure proper dilution of gas-air mixtures.

4. All air handled by the equipment, including combustion air, must be brought in from outside—recirculation of interior air is considered a potential hazard due to build-up of contaminated air and the possibility of an explosion.

5. The ratio of gas input to the total quantity of mixture discharged by the equipment shall not exceed 0.2 percent—this limitation is another assurance to keep the dilution of air to gas to the prescribed minimum.

6. The equipment shall be electrically tied in with its corresponding exhaust system so that it can be in operation only when the exhaust system is in operation.

7. The equipment shall be provided with air-flow sensing devices so designed and installed as to shut off the gas burner upon failure of either combustion-air or main-air supply.

8. The equipment shall be provided with combustion safeguards, including quick-acting, manual-reset safety shut-off valves, and with combustion-air-gas interlocks.

9. The equipment shall be provided with both a thermostatic device (for normal operation of the gas-burner component) and a high-temperature limit control. The latter shall be set at a temperature not to exceed 120°F.

10. The equipment shall be so installed as to not raise the temperature of surrounding combustible material to higher than 160°F.

Items 7-10 are part of the control circuitry and are in line with the company's normal requirements and those of the Factory Insurance Association. ▲▲

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Factors Governing . . .

# Size and Space Needs Of Electrostatic Precipitators

by Robert L. Brown*
*Senior Contract Engineer*
*Industrial Gas Cleaning Dep't.*
*Koppers Company, Inc.*

Whether you are planning purchase of a precipitator for air cleaning, product recovery or both, you'll need to know how air cleaning performance specs affect size of unit.

**Mr. Brown is a graduate of the University of Maryland, holds a degree in mechanical engineering and has been with Koppers for the past ten years as an engineer on precipitators.*

MANY PHYSICAL FACTORS contribute to the size and design of an electrostatic precipitator installation. Most of these factors are furnished by the supplier of the equipment, based on past experience on similar applications, pilot, and resistivity studies, etc. Some factors are frequently beyond the control of the supplier and must be assumed by him if not furnished by the user.

The objective in determining size and design for the unit is, of course, to select the most economical equipment which will furnish the desired cleaning efficiency or outlet grains loading while making the most efficient use of the available space. Factors such as possible duct arrangement, space allowance for dust removal system, sectionalization of the unit for most efficient utilization of power, sectionalization for rapping purposes, degree of required access, design pressure, design temperature, dust density and required dust storage are some of the points which must be considered when sizing the unit.

The precipitator may vary in height, width, and length to adapt it to the available space and to accommodate a duct arrangement which will offer a uniform gas distribution over the face of the unit. While perforated plates are provided by most manufacturers to insure some degree of gas distribution, uniform distribution should be gained and maintained throughout the entire duct system. As an example of the flexibility in sizing a unit to accommodate the available space, Fig. 1 shows three units which will offer approximately the same cleaning efficiency.

Positive and reliable dust removal is an important factor contributing to satisfactory precipitator operation. Various means are utilized to accommodate dust removal. Three basic systems for dry dust removal used are pyramidal hoppers, bunker hoppers, and drag scraper mechanisms. Wet removal with water washed internals is used on some applications, such as blast furnace gas cleaning, where a deoxidizing atmosphere is maintained to minimize effects of corrosion. Wet removal is also used with the collection of liquid as acid mist and in the paper industry when it is desirable to return dust to the system in solution.

### Pyramidal Hoppers

The pyramidal hoppers shown in Fig. 2 are adaptable to sequence removal, allowing for storage. Removal may be accomplished by pneumatic system (vacuum or pressure), screw conveyor or belt conveyor using a rotary or double flap type valve to maintain a seal in the unit. The quantity of hoppers to use is an economic consideration. Using an established valley angle (55° for most dusts encountered), the quantity of hoppers may be increased to minimize the depth of hopper and thereby the height of supporting structure. This also increases the number of discharge points and the extent of the removal system. The quantity of hoppers may be reduced, conserving on the extent of the removal system, while increasing the hopper depth and supporting steel requirements. Because of sequential removal, the hoppers are susceptible to pluggage, due to the cooling of the dust in the hoppers. Expedients such as aeration, steam tracing, and vibrators have been utilized to minimize pluggage.

Bunker hoppers shown in Fig. 3 have somewhat the same consideration as the pyramidal hopper. A slope angle of 60° will accommodate most dusts encountered. Removal is generally accomplished by screw conveyor. Dust may be continuously emptied, or stored with intermittent removal. While the bunker is less susceptible to pluggage, the dust may bridge the removal system as the result of cooling of the dust during storage.

The drag scraper mechanism shown in Fig. 4 has the advantage of continuous removal of hot dust from a single point, minimizing pluggage problems. Single point removal decreases the possibility of air in-leakage on negative pressure units, with resultant reentrainment. Continuous removal

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also reduces the possibility of re-entrainment frequently encountered with the storage type removal system. The unit may be placed directly on a concrete pad. When duct arrangement or other considerations dictate that the unit be placed on supporting steel, the area beneath the precipitator is frequently utilized for auxiliary equipment. Being a mechanical system, normal preventive maintenance is required to insure continuous operation, although extremely slow speeds keep this to a minimum.

Realistic design pressure, temperature, and dust densities are factors which to some extent are controlled by the user. Units designed in accordance with American Institute of Steel Construction specifications are provided with a liberal safety factor to accommodate surges in temperature, pressure, and unanticipated overloads of dust. Exaggerated design data coupled with safety allowances in the AISC Code may result in a structure heavier than warranted.

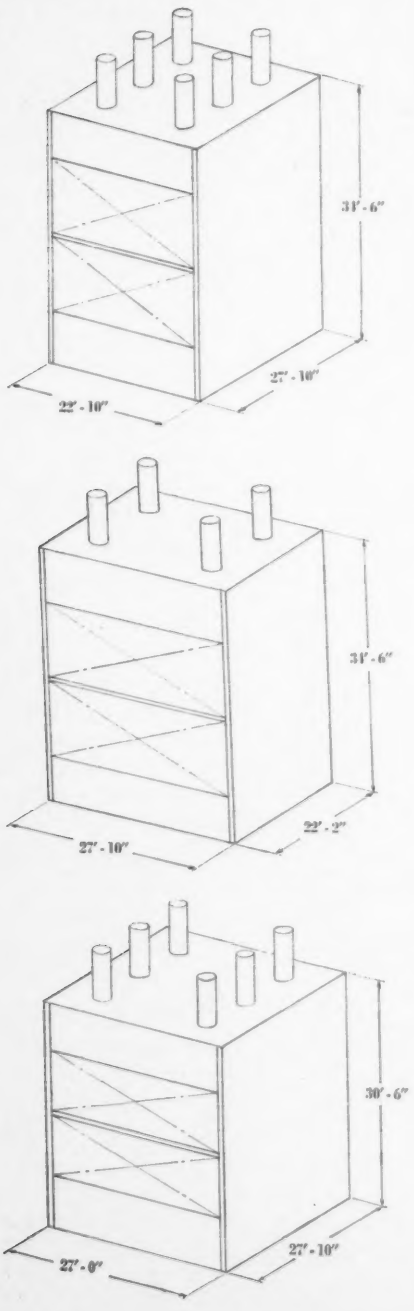
Dust densities vary considerably on similar installations due to differences in fuel or ore used and by additional cleaning devices in the system. While a high dust density will result in a rugged structure, it will also result in a deficiency in the dust removal and storage facilities since:

$$\text{Dust Collected (cu. ft./min.)} = \frac{\text{Gas Vol. (cfm) x Dust Loading (gr./cu.ft.)}}{\text{7000 grains/\# x Density (\#/cu.ft.)}}$$

Realistic high and low values for

*(Please turn to page 49)*

*Fig. 1:* Although the three precipitators below vary as to size, they perform equally as well.



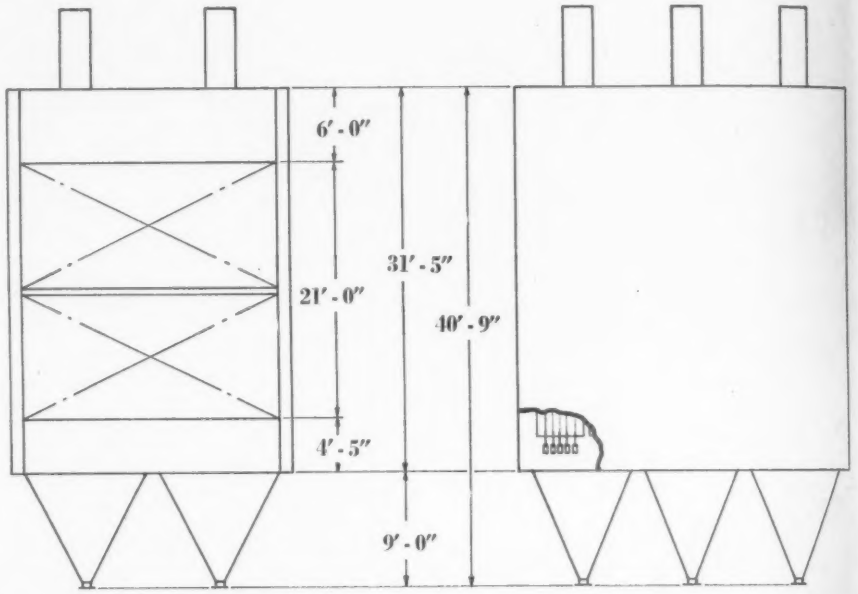




*Fig. 2:* Pyramidal hoppers shown above are adaptable to sequence removal, allowing for storage.

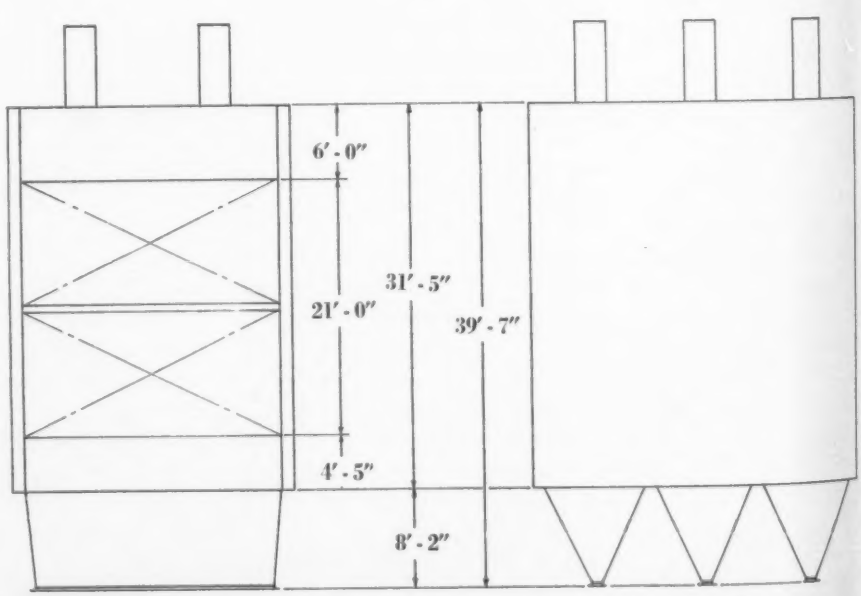
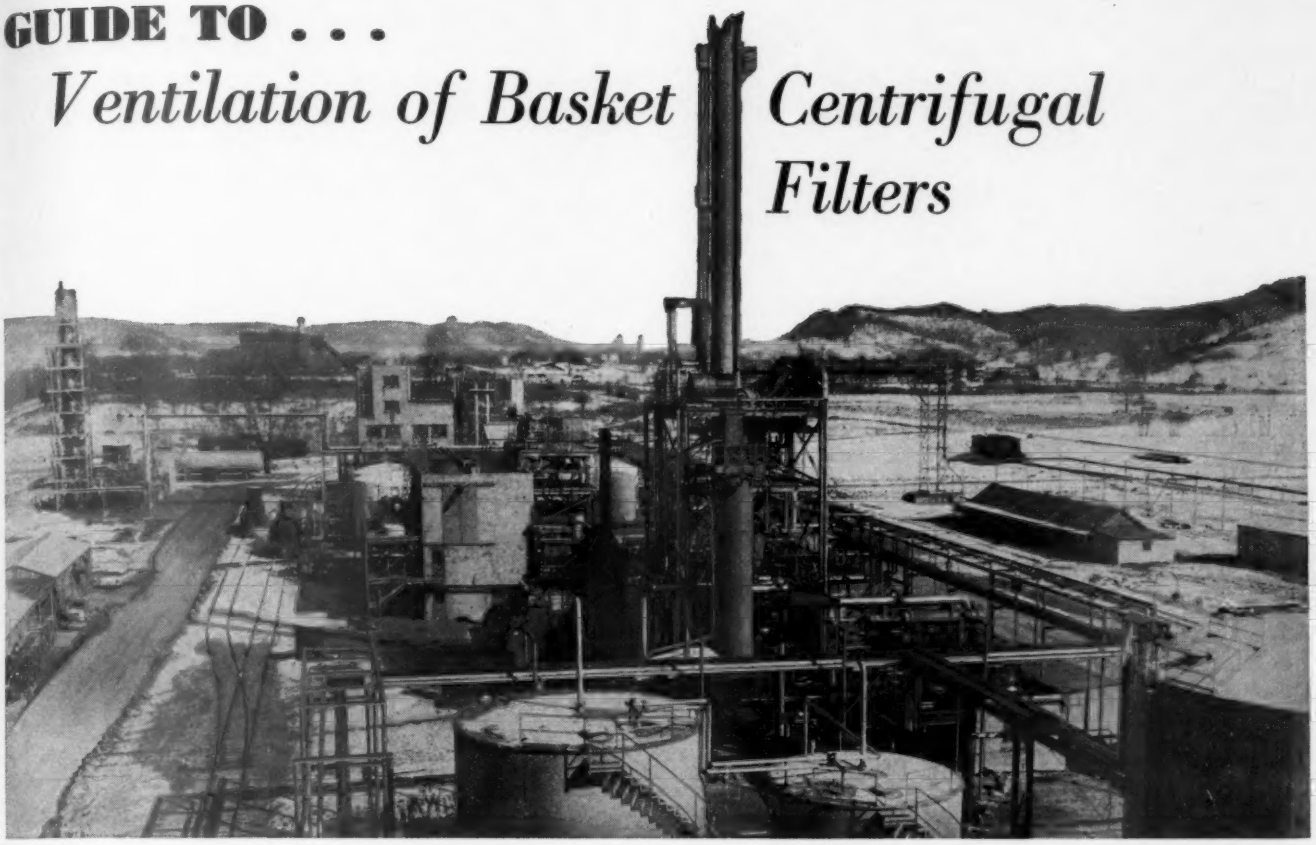



*Fig. 3:* Bunker hoppers may also be used for storage, although dust may bridge the removal system as result of cooling of dust.

**GUIDE TO . . .**

# *Ventilation of Basket Centrifugal Filters*



*View of American Cyanamid Co.'s new aniline manufacturing facilities at Willow Island, W. Va. Plants such as these require careful design of ventilating systems to maintain employee health.*

**By William V. Andresen**
***Chief Industrial Hygienist***
***American Cyanamid Co.***

Practical ways to protect the operator from hazardous vapors and solids during charging, washing and unloading cycles of basket centrifugal filters. Hood design and mechanical exhaust ventilation data are given in this article.

THE BASKET CENTRIFUGAL FILTER is used in many chemical processes for the batch separation of solids from liquids.

The centrifuge consists of a porous basket into which a liquid-solid mixture is charged. The liquid is filtered through the sides of the basket by centrifugal force as the basket is rotated. The filter medium utilized in the basket centrifuge may be metal mesh, cloth or paper which retains solids while allowing liquid to pass through and be discharged.

The filtered solids are often washed by addition of liquid to the centrifuge.

The solids are then unloaded from the basket and transferred to separate containers.

Since a variety of hazardous solids and liquids are utilized, there are many potential industrial hygiene problems encountered in the use of the basket centrifuge. The operator may be exposed to hazardous or irritating concentrations of vapors during the charging, washing and unloading cycles when volatile liquids are processed. He may be exposed to spray, mist or wet solids which may be toxic or irritating during the filtration and washing cycles.

Hood enclosure and mechanical exhaust ventilation may be utilized to control these contaminants.

There are two general types of centrifuges used for batch filtration in chemical processing; the underdriven type and the overdriven type. Loading of an underdriven centrifuge may be done with the centrifuge standing still but is also done through feed pipes while the centrifuge is rotating. To insure proper loading of the centrifuge, it is sometimes

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***WILLIAM ANDRESEN** is chief industrial hygienist for the American Cyanamid Co. A graduate engineer, he is vice chairman of the Bergen County, New Jersey air pollution control committee. He is also a delegate from the National Safety Council to the American Standards Association committee Z-9 on industrial ventilation. He is a member of the American Industrial Hygiene Association.*

*(Continued from preceding page)*

necessary for an operator to observe the operation.

The removal of material may be performed by scoop or shovel from the basket. In some instances, a filter cloth with the filtered material may be removed from the centrifuge.

It is often possible to make an underdriven centrifuge gas-tight by the use of a hinged and gasketed cover and closed feed and discharge lines. This will prevent escape of vapor, mist or spray during filtration and washing cycles. A problem may, however, exist when the centrifuge is unloaded due to residual vapor or gas in the centrifuged solids. Draw through ventilation as shown in Fig. 1 may be utilized to provide the desired control. A control velocity of 100 fpm through the open area of the centrifuge will usually provide satisfactory control.

The operator may also be exposed to residual vapors escaping from the drum or container into which the filtered solids are emptied. Slot ventilation for the drum as shown in several previous articles in AIR ENGINEERING may be used to provide the desired control.

Draw through ventilation is not usually used for overdriven centrifuges because of the difficulty of sealing the centrifuge.

Hood enclosure ventilation may be used for control purposes in the operation of the overdriven centrifuge as well as for underdriven centrifuges.

Fig. 2 shows a hood enclosure for an overdriven centrifuge. The front part of the centrifuge should

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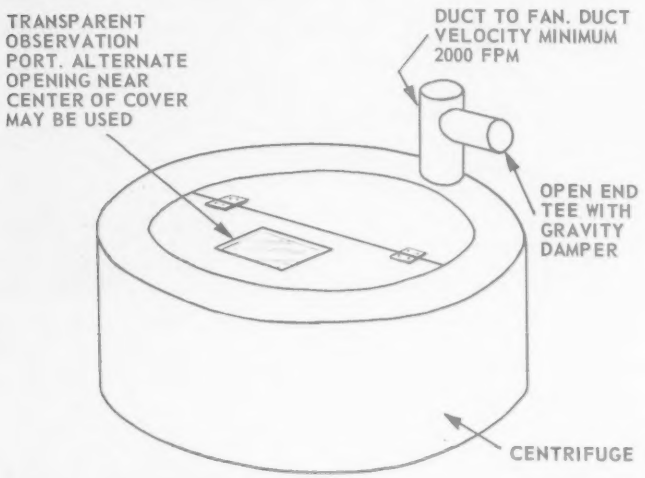

TRANSPARENT OBSERVATION PORT. ALTERNATE OPENING NEAR CENTER OF COVER MAY BE USED
DUCT TO FAN. DUCT VELOCITY MINIMUM 2000 FPM
OPEN END TEE WITH GRAVITY DAMPER
CENTRIFUGE

*Fig. 1:* **Draw-through ventilation for an underdriven centrifuge shown here will control residual vapor or gas in centrifuged solids when centrifuge is unloaded.**

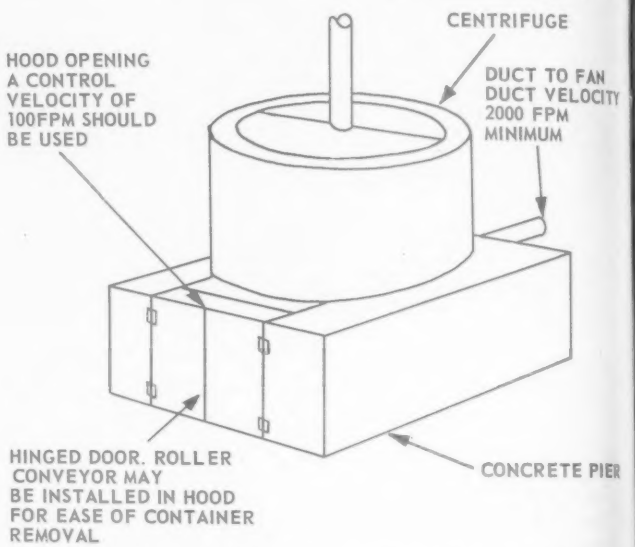

CENTRIFUGE
HOOD OPENING A CONTROL VELOCITY OF 100FPM SHOULD BE USED
DUCT TO FAN DUCT VELOCITY 2000 FPM MINIMUM
HINGED DOOR. ROLLER CONVEYOR MAY BE INSTALLED IN HOOD FOR EASE OF CONTAINER REMOVAL
CONCRETE PIER

*Fig. 3:* **Enclosure design for bottom of overdriven centrifuge for control of filtered solid fumes. Use control air velocity of 100 fpm.**

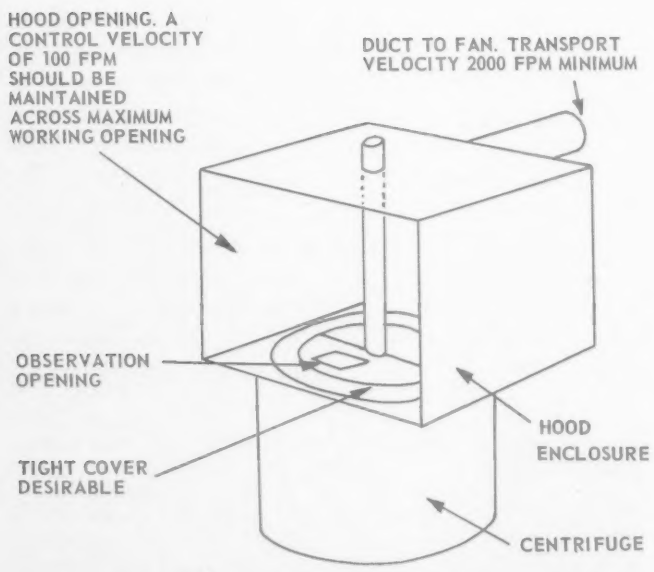

HOOD OPENING. A CONTROL VELOCITY OF 100 FPM SHOULD BE MAINTAINED ACROSS MAXIMUM WORKING OPENING
DUCT TO FAN. TRANSPORT VELOCITY 2000 FPM MINIMUM
OBSERVATION OPENING
TIGHT COVER DESIRABLE
HOOD ENCLOSURE
CENTRIFUGE

*Fig. 2:* **Hood enclosure for an overdriven centrifuge. Use 100 fpm for air flow. Same hood design may also be used for underdriven centrifuges.**

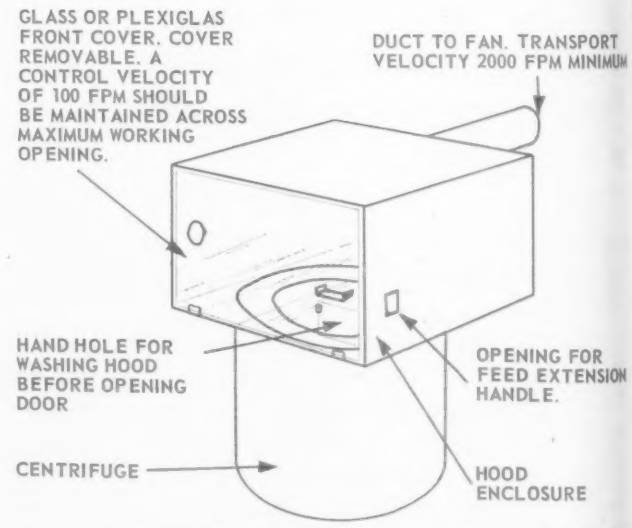

GLASS OR PLEXIGLAS FRONT COVER. COVER REMOVABLE. A CONTROL VELOCITY OF 100 FPM SHOULD BE MAINTAINED ACROSS MAXIMUM WORKING OPENING.
DUCT TO FAN. TRANSPORT VELOCITY 2000 FPM MINIMUM
HAND HOLE FOR WASHING HOOD BEFORE OPENING DOOR
OPENING FOR FEED EXTENSION HANDLE.
CENTRIFUGE
HOOD ENCLOSURE

*Fig. 4:* **In centrifuge operations where contact with ultra-hazardous materials cannot be made, the complete enclosure shown here will protect the operator. Control valves are outside of enclosure, which is closed with glass or plexiglass cover.**

# *New Trends In Hospital Incineration Design*

by **Morgan C. Larkin**
*Nash, Cadmus and Voelker, Inc.*

**The changing pattern of hospital wastes, with its vastly greater thermal value, focus new attention on improved means of waste disposal. Here are some of the waste disposal problems faced by hospitals today and how they may be solved with new incinerators.**

IT IS INHERENT in the nature of hospitals that housekeeping must be immaculate and it is equally inherent in the nature of hospitals that they produce wastes that are particularly unpleasant in handling and disposition.

Incineration on the premises has long been a partial solution to this problem. Increasing pressure from smoke abatement authorities as well as the equally important sanitary and public relations reasons have of late years moved in a direction to eliminate all hints of offensive odors in the stack gases or surrounding areas of the incinerators. The modern hospital is usually in the midst of a residential area as well as being surrounded by its own spacious parking lots where flyash or unburnt particles would be objectionable.

The first results in the tendency toward the elimination of nuisance has been prohibition of the familiar flue fed incinerator for new construction or replacement in older hospitals.

It is generally accepted practice that to destroy organic gaseous or particulate matter which may cause odor, temperatures at a minimum of 1350°F must be obtained. With the unrestricted air flow and impossibility of installing a practical damper in the stack from flue fed incinerators, there has been no way to achieve this end. Further, no method of combining a secondary combustion and settling chamber with flue feeding has yet been satisfactorily worked out. Consequently, almost all new hospital construction and most older hospital replacement work now call for the "heavy duty" or

*(Please turn to following page)*

### MODERN HOSPITAL INCINERATOR PROBLEMS

- Less food preparation garbage, more paper, due to frozen foods
- Motorized garbage grinders eliminating garbage waste.
- Increased use of paper products in patient care, including paper dressings, wrappings, dosage packaging
- Thus, increase of waste thermal value from 2500 btu/lb to 6500 btu/lb
- Old horizontal hearth, wet type incinerators not able to handle new fuel. Slower, uses more labor, has far greater flyash and smoke carryover due to higher gas velocities
- Increased bed capacity without increased incinerator capacity
- Use of incinerators by untrained personnel

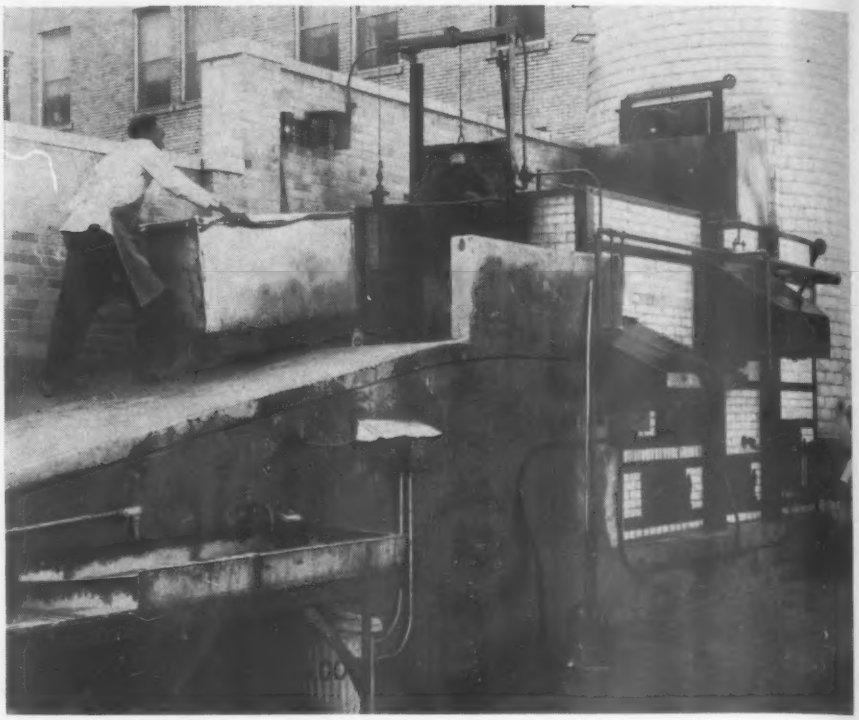
# Hospital Incinerators

*(Continued from preceding page)*

"destructor type" incinerator.

More precisely, incinerators of this heavy duty construction would be defined as Types III and IV according to the designation of the Incinerator Institute of America. This type of incinerator has not been a stranger in hospital service as for years destructors were used for all or part of the kitchen and pathological refuse. At the same time, in many institutions, the bulk of the floor waste was dropped into chutes to auxiliary flue fed incinerators.

As hospitals expanded the heavy duty destructors were not only overloaded, but their location usually meant that the floor personnel began dropping into the flue fed unit much objectionable material these incinerators were not capable of handling. Such a practice gave rise to an internal and neighborhood nuisance which many administrators as well as hospital designers have taken action to correct.



An 800 lb/hr incinerator at Ohio Valley General Hospital, Wheeling, W. Va. Shown are loading ramp, primary and secondary burners under weather hoods, thermocouple, and at charging operator's left, red and green operating lights with audible alarm to prevent opening door during periods of low temperature. Secondary burner is also regulated by this control system. Controls designed by James C. Martin, then the municipal air pollution control chief.

### Incinerator Trends

To understand some of the present practices in hospital incineration we should look back far enough to see a developing trend. The original hospital waste for the destructor type incinerator was exceedingly moist. This included the direct garbage from the kitchens, usually saturated with wash water and other fluids. Plate scrapings from meals were included as well as dressings and pathological material from maternity and operating rooms.

The general liquid content of these charges resulted in the development of the horizontal hearth incinerator with a low roof arch and restricted combustion volume. In spite of the use of burners the total heat release was low due to the evaporation of moisture. The roof arch was brought low over the charge to more effectively reflect the heat. A small grate was provided at the end of the hearth where dry materials could be placed, as well as furnishing surface on which, in some areas, coal or coke could be burned as a source of auxiliary heat. The hearth was so located that the exit gases having passed over the charge would return underneath the hearth, heating this slab from the bottom and assisting in the drying of the material.

This meant a restricted ignition chamber volume, with resultant poor design for large quantities of dry materials, which produced high temperatures and copious volumes of gaseous products of combustion. Unsatisfactory as this design may have been for dry materials, it was and is an excellent one for moist charges and is by no means outmoded where service demands this construction. For thirty years this has been known as a "hospital" incinerator and included in new construction by architects without question as to design. Hundreds have been installed and have given excellent service.

However, a few years ago hospital wastes underwent a radical change. Frozen food made its appearance, cutting down the production of food preparation garbage in the kitchens and adding to the accumulation of dry waxed paper container waste. Motor operated garbage grinders in the sinks began to be used thus rendering waste from the kitchen area almost negligible, where this had heretofore been preponderant.

### Higher Thermal Values

Paper products in direct care of patients increased markedly. Patients brought with them habits of freely using facial tissues. Alert pharmaceutical houses were introducing highly absorbent paper dressings with many of these packaged into "kits" for specific operations. These began to be used in greater number than the conventional gauze applications and we had not only the more bulky materials of the dressings but also the wrappings of the "kits" finding their way into the waste collection system. Bulk shipment of pharmacy supplies has for an even longer time been giving way to individual and dosage packaging,

all contributing to an appreciably greater paper and cardboard rubbish.

So to speak, hospital wastes "dried up" and tremendously increased in heat content. Roughly, this thermal value increased from 2500 btu per pound to certainly more than 6500 btu per pound.

The horizontal hearth, wet type, incinerators were hard pressed to handle this new fuel. Heat release in the small volume chambers increased beyond the bounds of good practice (set at 25,000 btu per cubic foot by the I.I.A.). Linings which had stood up for years suddenly became maintenance problems and the intricate hearths collapsed. Labor costs increased as the more bulky material required a longer time to charge. Gas velocities in the incinerators and stacks increased considerably with consequent carry-over of flyash and smoke.

### Greater Patient Load

To add to these difficulties, many hospitals increased bed capacity in accord with present day patient demand without correspondingly increasing the incineration facility. Also, as flue-fed incinerators were taken out of service they were not replaced, thus directing even more dry material to the heavy duty destructor.

The state of affairs is usually at this point when a smoke abatement officer or consulting engineer enters a hospital having incinerator difficulties. The solution is frequently the provision of greater capacity for the consumption of dry wastes. This object can be accomplished either by remodeling the existing unit or installation of new equipment.

Remodeling is practical where the external shell of a horizontal hearth incinerator is in good condition and where the structural steel framing is intact. It may then be possible to strip out the firebrick lining, demolish and remove the hearths and arches, and install a new and larger grate with relocated bridge and curtain walls.

Invariably the flue connection must be replaced to accommodate the larger gas volumes. Sometimes height may be increased, with or without the use of a hood charging arrangement. In any case, the governing limitation in such an increase of dry capacity will be the allowable increase in the after chambers and flue cross sections to handle the new volume of gases at reasonable velocities. Any of the leading incinerator firms will be glad to submit recommendations for such alteration. The rebuilt unit should carry the same guarantee as a new installation.

### New Incinerator Designs

New incinerators for hospitals of 400 beds and greater are frequently designed for dry materials, otherwise designated as Type I waste by the Incinerator Institute. This waste may be all dry or may contain up to 20 percent of wet materials. Such construction has a complete cast iron grate with no hearth, the usual downpass, and combustion chamber with brick checkerwork before the flue connection exit. Hospitals of this size are preferring units with nominal capacities of from 600 lbs./hr. up to 1000 lbs./hr. of wastes.

Flow of fuel in these cases is of sufficient bulk and heat content to permit burning of pathological wastes without the use of hearths. The firebed is active and deep and retains fluids and moisture. One 750 lbs./hr. incinerator of such construction is now destroying 10 to 12 dogs per day, each weighing up to 40 pounds, along with the regular hospital rubbish and pathological material from surgery. It was not found necessary in this case to build a separate unit for the animal wastes.

Small hospitals with less mass of rubbish and with intermittent firing periods still find their best selection to be some adaption of the hearth type incinerator. This may be a unit with a large ignition chamber and a simple hearth adjacent to the grate. Such an arrangement permits destruction of organic matter whether or not dry material is available for mixture. The mixture would be necessary if combustion were to be on only a cast iron grate surface. Pathological material must be disposed of immediately, hence a hearth is provided to receive it for subsequent destruction by burners.

The most effective means of preventing nuisance from hospital incinerators is to provide each unit with two burners. One burner, called the primary burner, is located in the ignition chamber and furnishes the heat to ignite rubbish and make up thermal deficiencies in the fuel due to moisture. The second burner, appropriately called the "secondary" burner, is located in the downpass or passage between the bridge and curtain wall. This burner preheats the after chamber and assures combustion of any vaporous materials not completely burned in the ignition chamber.

### Instrumentation

Instrumentation and control for a hospital incinerator revolve around a thermocouple or other temperature sensing device placed in the combustion chamber or flue connection. The purpose is to assure that at all times during operation the temperature does not

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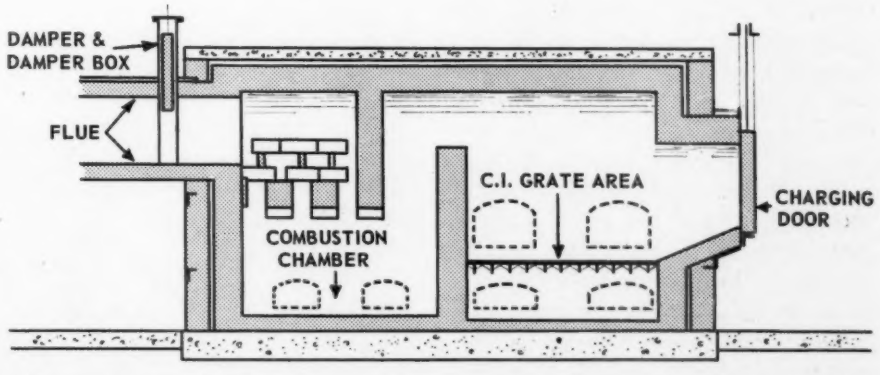



Cross-section of typical large hospital incinerator, designed to handle modern hospital waste with its higher thermal value due to greater use of paper products, less wet waste because of motorized garbage disposals, etc.

# Hospital Incinerators

*(Continued from preceding page)*

fall below 1350°F.

The simplest adaption of this is to have the thermocouple attached to an indicator scale or to a red and green light. The operator is instructed to turn on the secondary burner when the temperature is below the designated value, or when a red light shows. A controller can be added to take over these functions automatically.

### Safety Interlocks

Some hospitals have added interlocks which prevent the opening of the firing door during periods of temperature deficiency and start-up. With any of these arrangements or adaptions of them, it must be remembered that the available help for the incineration operation in hospitals will generally not be of the same caliber as licensed boiler firemen. Consequently instruments or controllers which require any maintenance in upkeep, or judgment in use, must be carefully selected. As always, the rule of "the simpler the better" holds with particular force here.

The two types of incinerators discussed above, the "all dry" unit and the modified hearth unit, meet the requirements for all general hospital wastes. From this point on, a hospital may specialize with individual and usually smaller incinerators.

### Pathological Incinerators

Frequently an autopsy room or surgery on an upper floor may require a small "crematory" or pathological incinerator located at a short convenient distance. These are usually light, steel cased units with a nominal capacity of 100 lbs./hr. and under. They are built with a refractory slab hearth and no grate surface. Nothing except pathological material is to be charged into such units.

If a hospital has an extensive animal laboratory it may be desired to destroy animal cadavers along with cage cleanings. This is a common application in pharmaceutical houses and university pathology departments. The requirement is met by an incinerator having a sloping hearth, heated from both sides, a small grate area, and an adequate furnace volume for the required dry materials. The sloping hearth for animal matter is provided with a dam at the bottom to prevent the contamination of the ash by fluids and fats melting and running through the grates.

The construction and type of incinerator can easily be worked out with the architect or an incinerator manufacturer. The hospital's chief concern will be attention to materials handling.

### Feed Methods

Incinerators may be fed through a charging door located about three feet from the floor. If the incinerator can be depressed (or the charging floor raised) the door sill may be placed at floor level. This is a highly satisfactory method. Another method is to provide a chute to the incinerator on the floor below, closed with a pivoted refractory cover. The charging hole is best protected by a steel pan with drain. This prevents the absorption into porous concrete of rancid fluids from garbage and other noxious materials.

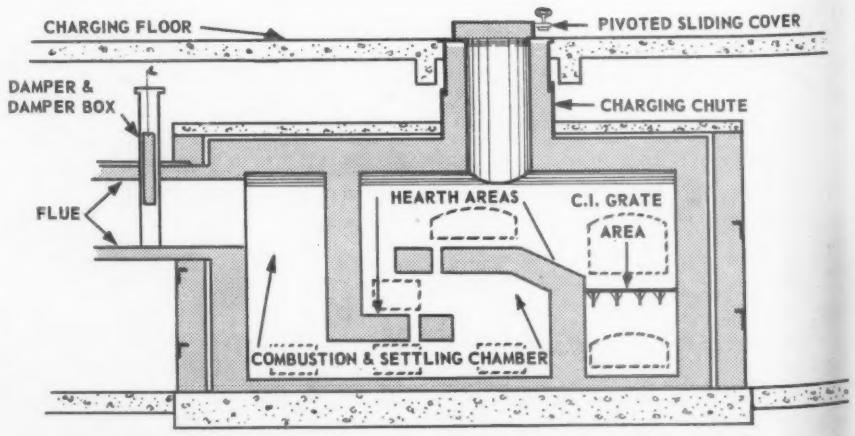
### Transport Methods

With the disappearance of the flue-fed incinerator, rubbish must be moved to the incinerator room either by wheeled containers and elevators, or by a rubbish chute discharging into a fireproof rubbish storage room in accord with the requirements of the National Board of Fire Underwriters Bulletin No. 82. From the rubbish room another handling operation takes the material to the incinerator.

To avoid air pollution either from odor or flyash, the hospital employees must be trained in the proper use of the incinerator. At least one person must be assigned full responsibility for the operation, cleaning of fires and ash pit. He should have an understanding of the capabilities and limitations of the incinerator. It is found that where a great many people charge the incinerator the responsibility lies with everybody and consequently nobody. The most painstaking directions and printed instructions will take the place of one employee who is concerned with the proper operation of the incinerator.

### Conclusions

It is hoped that this exposition will enable smoke abatement officers to more completely understand the problems of hospitals. Obviously it is unpopular to put into effect the same kind of a "get tough" policy against these non-profit and public service institutions as may be brought against private industry. Generally this is not necessary as hospital boards are only too glad to cooperate on a policy of non-replacement of sub-standard equipment. With renovation and new construction, hospitals are continuously improving as good neighbors and examples of satisfactory incinerator practices in face of many difficulties. ▲▲




Cross-section of incinerator designed to handle high proportion of wet wastes.

**Practical ways to handle . . .**

# *Dust Collection Methods For Steam Power Plants*

**Part I**

**by Gregory Gould***
***President***
***Fuel Engineering Co.***

Above: Effluent from pulversized fuel fired industrial boiler. Below: After precipitator energized. Photos courtesy Aerotec Industries, Inc.

THE APPLICATION OF EQUIPMENT to air pollution control in the steam power plant field has been limited almost exclusively to removal of dust. Much effort has been expanded in trying to find ways to remove sulfur from our fuels and alternatively, $SO_2$ from flue gases. As yet no universal economic and feasible method has been found. The recognition of oxides of nitrogen as undesirable constitutents in flue gases is relatively new and efforts to correct the situation have only begun.

Of all the devices which might be used for removal of particulates, centrifugal collectors and electrostatic precipitators have proved to be the most promising. We may yet see bag houses, venturi scrubbers and packed towers used in the steam generating field but, at the moment, this is not the case. The efficiency of the mechanical collector depends largely upon the size distribution, shapes, and densities of the dust. The efficiency of the electrostatic precipitator is a function of the resistivity and dielectric strength of the ash, the velocity with which the particles move through the precipitator and other mechanical design details.

Other characteristics of flue dusts which have a bearing on design and performance of collectors and precipitators are the abrasiveness, adhesive and cohesive properties. Optical properties are also important from an air pollution standpoint as will be explained later.

Both centrifugal collectors and electrostatic precipitators are sensitive to uneven gas and dust distribution at their entrances. Space for such devices is generally very limited and frequently physical arrangements are somewhat less than aerodynamically ideal. Sharp

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*Mr. Gould is a registered professional engineer in N.Y., a member of: Air Pollution Control Assoc., Amer. Soc. for Testing Materials, Nat'l. Soc. of Professional Engineers, Amer. Soc. of Mech. Engineers, N.Y. State Society of Professional Engineers, Inc.

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bends and short transition pieces with much greater angles than venturi discharge angles tend to produce uneven distribution of both gas and dust across the entrance cross-section that will seriously decrease efficiencies. Various devices such as spreaders, turning vanes, and perforated baskets are used in efforts to overcome these problems.

The temperature of the flue gases entering collection equipment will affect collection performance of both centrifugal collectors and electrostatic precipitators. With high sulfur fuels, the acid dew point ranges up to 350°F. As gas temperatures drop below this temperature, increased difficulties with corrosion of metal surfaces occurs. Plugged and fouling difficulties with tubular collectors also increase. The resistivity of flyash varies with temperature and reaches a peak approximately at 300°F. Peak resistivities of some flyashes are high enough to seriously depress electrostatic precipitator performance. Yet 300°F. is thermo-dynamically attractive as far as boiler plant efficiency is concerned. The two objectives are somewhat in conflict.

### Resistivity and Dielectric Strength

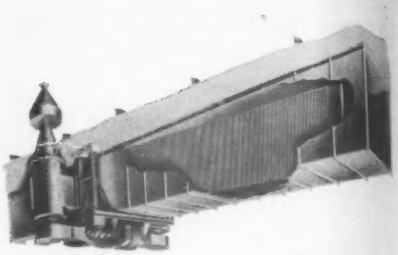
As the voltage drop across a layer of collected dust rises, its dielectric strength (the ability of a substance to withstand an electrical stress) may be exceeded. When this happens, the dust suddenly ruptures and a spark occurs in which a relatively high current flows. The precipitator is effectively short circuited at this point and the arc must be broken.

Because charging of the dust particles is accomplished with high voltage, maximum effectiveness is achieved by having the voltage as high as possible. The voltage which builds up across the collected dust depends upon its resistivity, and the maximum which can be tolerated depends upon its dielectric strength. When the resistivity exceeds about $2 \times 10^{10}$ ohm-centimeters, reduced performance is likely from excessive sparking.

Research has shown that the resistivity of flyash is closely related to the presence of water soluble sulphates and free sulfuric acid formed on the surfaces of the particles by absorption of $SO_3$ from the flue gas. If the sulfur is greater than 1 percent in a given coal, there is likelihood that there will be sufficient $SO_3$ in the flue gas. However, $SO_3$ is formed by the oxidation of $SO_2$ in a reversible reaction and occurs at temperatures between 750°F and 1500°F. The amount of $SO_3$ formed will depend on the basic design of the boiler and furnace; the rate of combustion and the time of contact with catalytic metal surfaces. The lower limit of soluble sulphate necessary to produce a favorable resistivity has been found to be on the order of 0.5 percent of the ash.

The quantity of magnesium and aluminum in coal ash is also believed to be a factor in producing poorer performance as a result of high resistivity. It is believed that flyash from strip-mined coal usually has higher resistivity than flyash from deep-mined coal, although the reason for this is not clear.

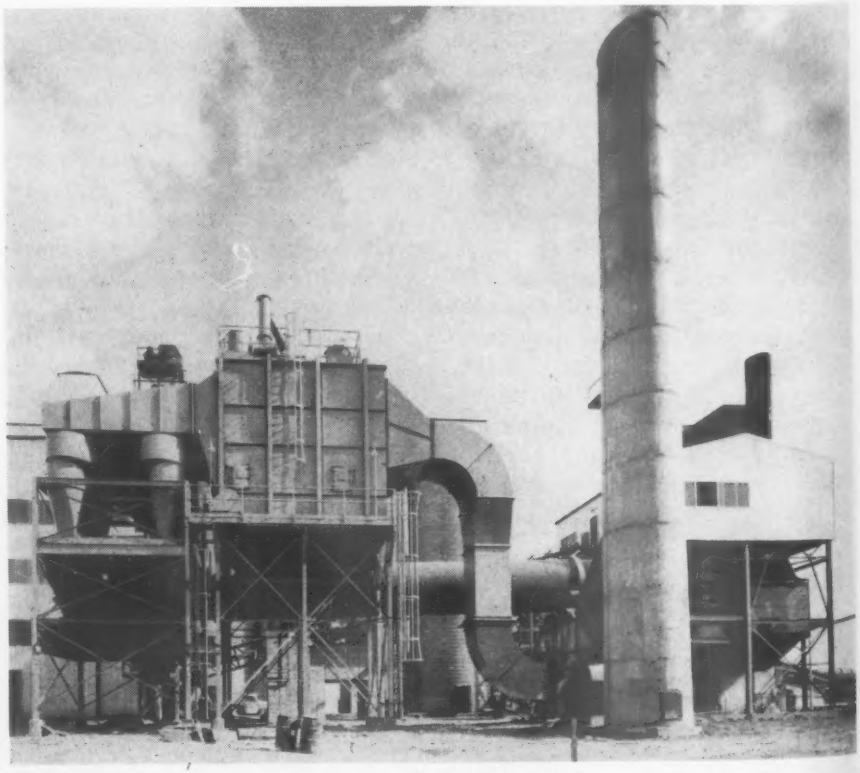
Flyash containing more than 15 percent carbon will begin to affect flat plate precipitator performance adversely. This effect is attributed



Above: Low draft loss collector used with stoker-fired boiler with precipitator on pulverized fired plants. Photo Buell Engineering Co., Inc.

to the fact that carbon is a relatively good conductor and will pick up and lose a charge readily. The theory is that upon striking a grounded collecting plate, a high carbon particle loses its charge immediately, and as a result of a phenomena called charge-by-induction, assumes a weak positive charge. It then becomes re-entrained in the gas stream. The process continues over and over until the particle escapes from the collector. The so-called pocket or screen grid collecting electrodes have been designed to overcome this problem and have proved to be effective. ▲

*Next month, Part II will discuss particle size distribution, methods of combining electrostatic with mechanical collectors, costs.*



Above: Cement plant showing the combined system of mechanical cyclone collector followed by electrostatic precipitator. Photo courtesy Buell Engineering Company, Inc.

*Every Morse Boulger Custom-Engineered Incinerator has built-in air pollution control...*

**According to the U.S. Public Health Service** you take in some 15,000 quarts of air per day. *This is 10 times as much by weight as your intake of food and water combined!* This startling fact underscores the vital importance to your health of efficient air pollution control measures.

**Every Morse Boulger incinerator installation** (from giant municipal plants to compact industrial units) is *custom-engineered* to make a significant contribution to the public health because of *built-in air pollution control.*

**Our engineering staff** (with a background of more than 70 years' pioneering in air pollution control) is available at all times for consultation, without obligation, to help solve *any* incineration problem *whatever it may be.*

## MORSE BOULGER, INC.

*Today's Engineering Backed by More Than 70 Years' Experience*

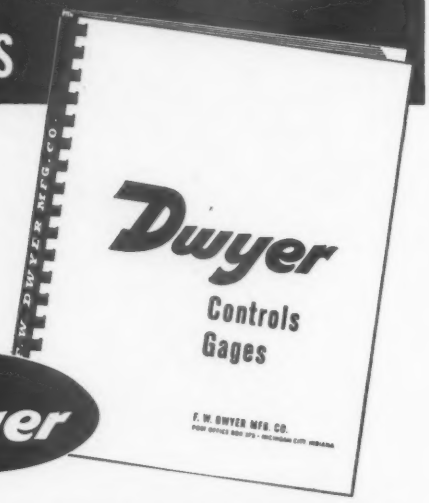
80 FIFTH AVENUE, DEP'T. 74, NEW YORK 11, N. Y.
WA 9-8000 • Representatives Everywhere

MEMBER:
*Incinerator Institute of America* • *Air Pollution Control Association*

# For the latest in Gages... Controls

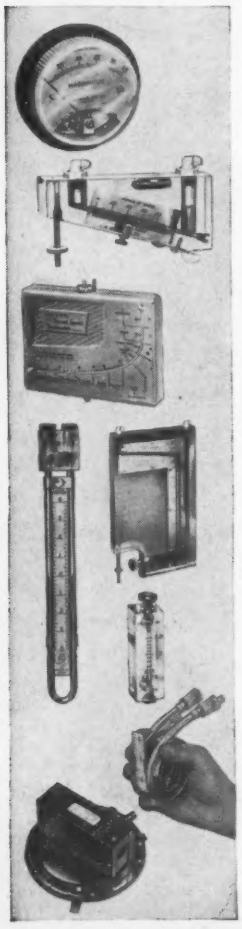
check the new

Dwyer




## INSTRUMENT MANUAL

Need a meter for *direct* reading of both air velocity and static pressure? An inexpensive gage that tells homeowners when to change air filters? A complete, accurate combustion test kit, or a manometer that *rolls* up to fit compactly in your tool box? You'll find these and many more money-saving ideas described in this free Dwyer manual. It's packed full of valuable information about Dwyer's complete line of instruments.



- Magnehelic Gages . . . velocity, resistance, draft, static and gas pressure.
- Inclined Tube Gages . . . draft, velocity, slight pressure variations.
- Air Filter Gages . . . models for every installation.
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- Air Velocity Meters . . . direct reading of air velocity and static pressure.
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- Wind Speed Indicators
- Slack-Tube Manometers . . . roll-up types.
- Flex-Tube Manometers . . . U-tube, well types.
- Inclined-Vertical Manometers
- Combustion Test Kit . . . for $CO_2$ content, draft, temperature, smoke.
- Pitot Tubes . . . inch-graduated, stainless steel.
- Pressure-Actuated Switches
- Special Instruments, Designs

*Send for your free copy today*

**F. W. DWYER MFG. CO.**

P. O. BOX 373-A • MICHIGAN CITY, INDIANA


# Super-Clean Rooms

*(Continued from page 23)*

The room has been in operation for the past nine months. Very few "bugs" had to be worked out of it. The results have been all that were expected.

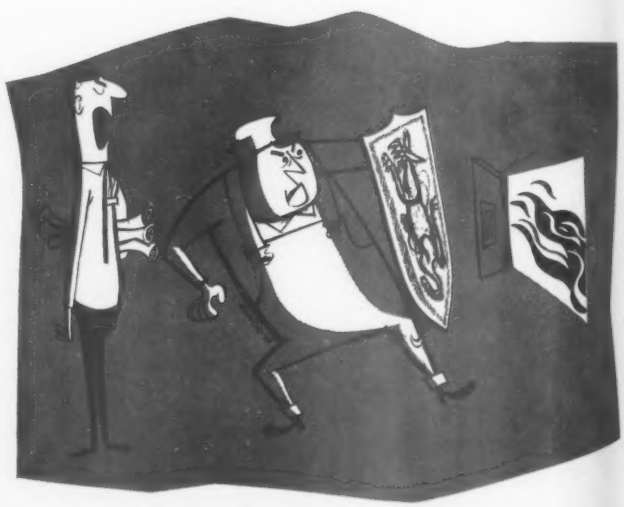
Dust counts have been difficult to obtain. Using a black-backed glass slide and a twenty-powered microscope no appreciable dust count was possible at the assembly bench level after three days.

Similar difficulties were experienced using a gelatin-coated slide. We would like to get into more sophisticated systems, but cost at the present time has been prohibitive. However, we propose to make a serious study of dust counting and have recently assigned technical help to this end. I might add that an article in the October issue of AIR ENGINEERING entitled "Fingerprinting of Air Borne Dusts" at Convair Division of General Dynamics Corporation, has given us some extremely valuable information.

If and when we build another room to fulfill a similar set of conditions, I think we would not make any major changes, at least not within our knowledge of the present state of the art. ▲▲

CREDITS

Corlon floor covering: *Armstrong Cork Co.*
Wall covering: *Formica Corp.*
Assembly cabinets: *Baker Instrument Co.*
Dacron clothing: *E. I. Dupont de Nemours & Co., Inc.*
Air Conditioning: *York Div., Borg-Warner Corp.*
Heating Boiler: *Kewanee (American-Standard Co., Ind. Div.)*
Electrostatic filter: *Westinghouse Electric Corp. and Trion, Inc.*
Sub-micron filter: *Mine Safety Appliance Co.*
Filter gauge: *F. W. Dwyer Mfg. Co.*
Controls: *Barber-Colman Co.*



**"But it's 40-below outside!"**

# New Literature

### "Facts On Lint Free Uniforms For Dust Control Areas"

The characteristics, benefits, properties, and construction features of synthetic fibers used by Angelica Uniform Co. are described in a bulletin issue by the Company.

Also included in the bulletin are swatches of the various fibers and weaves used for White Room uniforms.

**Circle #150 on page 51.**

### New Brochure On Heavy-Duty Oil-Gas Industrial Heaters

A new brochure providing complete information on Lennox Industries, Inc., combination oil-gas line of industrial heaters has just been published.

The new 12-page publication contains descriptions, technical data, and application photos of the various styles in which the OG4 unit is available. Blower performance charts are included for each of the units from 280,000 Btuh to 1,000,000 Btuh.

Other tables provide dimensional data, air handling capacities, heat exchanger area, motor horsepowers, additive cooling capacities, and plumbing data.

**Circle #151 on page 51.**

### "Hydrocarbon Emissions From Automobiles"

The Air Pollution Foundation has issued a report on the results of a study to measure the total hydrocarbon emissions from several automobiles.

Included in the report: exhaust emissions; crankcase emissions; carburetor evaporation losses; comparison of hydrocarbon emissions in road and chassis dynamometer operation; fuel tank evaporation losses; olefin content of evaporation losses; comparison of infrared and flame ionization analysis detector.

**Circle #152 on page 51.**

### Air Conditioning Control Valves Reviewed In New Bulletin

A bulletin describing "Selectaflow" dual-purpose year-round air conditioning control valves has just been issued by American-Standard Controls Div.

The folder explains how these self-contained thermostatic selector valves, designed for specific application to year-round air conditioning systems utilizing hot or cold water as a heat transfer medium with a single supply line and a single return line, eliminates the need for pneumatic lines or electrical connections.

Other advantages and features of these valves to architects, engineers, builders, building owners and occupants are cited. In addition, specifications on both direct and remote actuator types available are listed. Heating cycle and cooling cycle operations are illustrated by cross-sectional schematic diagrams.

**Circle #153 on page 51.**

*(Please turn to page 43)*

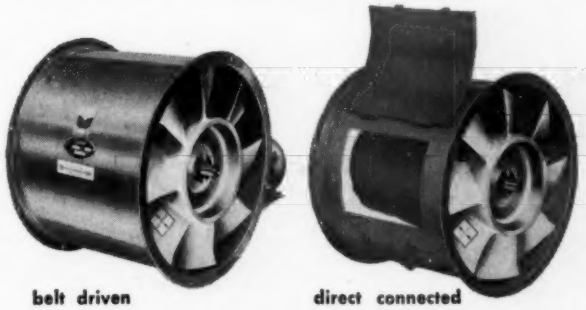
NEW 8 blade

Aerovent FANS

tubeaxial fans

high speed - high efficiency

Aerovent's new Tubeaxial Fan, designed around a new 8-blade "Macheta" Airfoil Axial Flow Propeller, offers top performance against medium pressures at speeds to 3450 RPM. Available in 16", 18", 24", and 30" diameters, this unit combines speed, stamina and modern functional design. Easily installed in present ductwork or engineered to new construction, it's the right answer for resistances to 4" SP. Another outstanding development from Aerovent—America's finest industrial fans and air equipment.



belt driven direct connected

WRITE FOR FREE BULLETIN 350

Air deliveries of Aerovent equipment determined in accordance with established and accepted codes and guaranteed by manufacturer.

CERTIFIED PERFORMANCE

Aerovent FANS

Aerovent FAN COMPANY, INC.

ASH and BRIAN STS. PIQUA, OHIO

# ? ? ? ? ? ? ? *Questions & ANSWERS* ? ? ? ? ? ? ?

## Question On Ventilation System For Gymnasium

The problem of providing ventilation for our Base gymnasium has been given to this section for a workable solution.

There seems to be two ways this can be accomplished, (1) by blowing air into the building from both ends of the building and exhausting it through window and door areas, or (2) exhausting air by using exhaust fans located in the down wind side of the building.

We would appreciate your comments.

*R. W. Ross*
*Mechanical Engineer*
*Harlingen (Texas)*
*Air Force Base*

**Answer**

It is assumed from the way the problem is stated that it is the intent of the designing engineer to accomplish the ventilation without heated supply or makeup air and in a simple arrangement not involving distribution ducts and supply diffusing grills. In the absence of further information the solution will be based on this premise.

Consideration of the satisfactory ventilation of the gymnasium involves the following factors:

1. **Air quantity**
2. **Air distribution**
3. **Introduction of the air free from objectionable drafts, excess cooling, etc.**

The quantity of air required is based mainly on the occupants, although some heat may be produced by the lights, sun load on building, etc. Odor, moisture and heat are given off by each person present. For satisfactory air conditions the ventilation rate will need to control these factors. Rates based on persons present should be in the minimum range of 15-30 cfm per person. Inasmuch as the metabolic rates (heat given off) is high in persons doing strenuous physical exercise the higher rate would be preferable.

In the absence of satisfactory occupancy figures, air flow rates are sometimes based on sq. ft. of floor area. Rates of 1.5 to 2.0 cfm per sq. ft. of floor area have been used. In the presence of intense sun loads, poor roof insulation, and small volume of space, higher ventilation rates should be used.

Good distribution would involve clean, fresh, outdoor air sweeping the entire area of activity with as much uniformity as possible. In the absence of duct work and multiple supply diffusers, a simple method of uniform distribution would be to supply the air through several openings on one side of the building, and exhaust it through several openings on the opposite side. The control of drafts through proper supply involves the introduction of air so that personnel are not subjected to air velocities higher than 50 linear fpm.

Introducing outdoor air at points some distance from personnel to allow loss of velocity and diffusion with warmer room air will help reduce drafts. Also if the air is introduced in small quantities through a number of small openings rather than one or two large openings, the distance of "throw" or higher velocity will be reduced. It appears on this basis it would be preferable to use method "2", "exhaust fans located on the downwind side of the building." If air is blown in the building from both ends it will be difficult to reduce the draft effect of the long throw of the fan supply opening. Approximately 10 percent of the outlet velocity is retained as far as 30 diameters from around supply opening. However, one diameter away from an exhaust opening the air flow is less than 10 percent of the velocity in the opening.

Inasmuch as the "throw" is a function of diameter of opening (or $\sqrt{\text{area}}$ for rectangular openings) and velocity, it would be preferable to allow the air to come in a number of openings (window openings, etc.) and exhaust the air on the opposite wall with exhaust fans. If several fans or exhaust openings were used, and a number of uniform supply openings provided, the distribution should be satisfactory for the entire ventilation system of the gym. ▲▲

**"Well, you asked for spot cooling!"**

# New Literature

*(Continued from page 41)*

## New Bulletin On Jet Compressors

Schutte and Koerting Company has just released a new bulletin on their line of jet compressors, including fixed-nozzle, manually controlled spindle, and automatically controlled spindle types.

The new bulletin details construction, operation and application information. It also includes a nomograph to determine the possible weight ratio of secondary gas to primary gas and a second nomograph to determine the compressor size.

**Circle #154 on page 51.**

## "Ultra Clean Rooms"

A new bulletin has been issued by Unistrut on the construction application of metal framing in ultra clean rooms. It gives the applications and advantages of Unistrut Metal Framing under controlled conditions as in a white room. An unlimited number of modern building materials can be coupled with the Unistrut Metal Framing, as vinyl, stainless steel or aluminum.

**Circle #155 on page 51.**

## New Concept Of Sound Rating

According to the Carnes Corp. Engineering Staff, this PWL/NC Index is the first simplified comparable sound rating method to be presented to the air distribution field.

It permits the use of a single number to express sound power level as a function of noise criteria; and, according to the literature, its use eliminates variables of the "A"-scale and NC method, because it is a measure of the performance of the equipment itself rather than of the results in a specific environment.

**Circle #156 on page 51.**

## Gas-To-Gas Heat Exchanger

Preheating combustion air, chemical processing, ventilating systems, air conditioning systems, drying processes, air purification systems, food processing, filtering systems, and fume and dust control are a few of the Roto-Pak® gas-to-gas heat exchanger applications listed in a new brochure from The Air Preheater Corp.

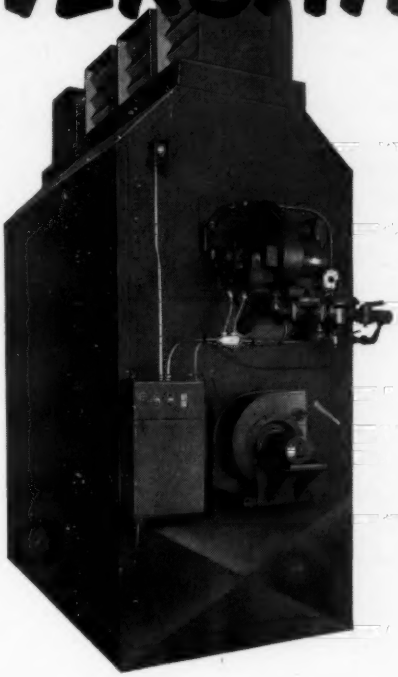
Also listed in the brochure are the Roto-Pak® structural details, operating specifications, and outline dimensions.

**Circle #157 on page 51.**

*Use Communications Center, page 51, for requesting more information about advertised products, new literature, or new products.*

*Circle the reference number corresponding to the item you wish more information about and mail on the postage-free cards.*


J-C Today's most VERSATILE direct-fired unit heater

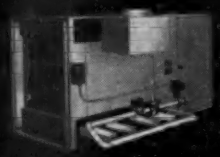


Model JC-200 2,000,000 Btuh output. Oil, gas or dual fuel.

Floor-mounted, horizontal, or inverted, this quality-built, factory-assembled, and fire-tested Jackson & Church direct-fired unit heater is proving ideal for hundreds of large-area heating jobs. Stainless steel, airfoil design combustion chamber eliminates refractory linings. Saves money on installation and maintenance. Available in outputs from 400,000 to 4,000,000 Btuh. Up-date your files with current specs. Write today.

J-C AMERICA'S LARGEST AND MOST COMPLETE WARM AIR FURNACE LINE.

12 Oil-fired Suspended models 123,000 to 1,000,000 Btuh output.



11 Gas-fired Suspended models 160,000 to 320,000 Btuh output.

12 Powerated Tubular models 208,000 to 320,000 Btuh output—Oil, gas or dual fuel.

37 Powerated Tubular models 400,000 to 3,800,000 Btuh output—Oil, gas, dual fuel, or stoker firing.

J-C DIVISION OF JACKSON & CHURCH YORK-SHIPLEY, INC. YORK, PENNSYLVANIA

Pioneers and Specialists in Automatic Heat. Boilers to 600 hp. Furnaces to 4,750,000 Btuh

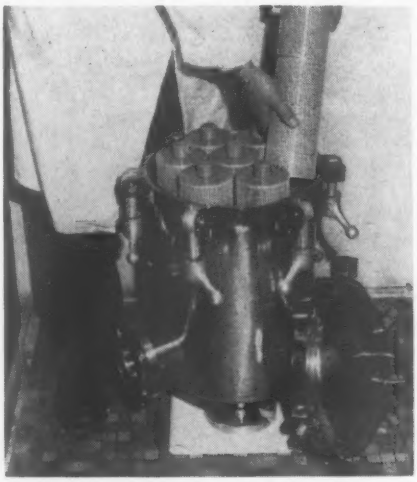
# *New* PRODUCTS

## Hydraulic Oil Filter

*Purpose:* Hydraulic and other petroleum-based fluids and water can be filtered to absolute 3-micron cleanliness by means of the TRI-PHANE® filter assembly at rates up to 170 gpm continuous flow. No recirculation or preliminary filtration is required. The unit, developed originally for use in processing bulk MIL-H-5606 hydraulic oil before packaging, features extremely high dirt capacity. It is a development of Aircraft Porous Media, Inc.

*Features:* The heart of the unit consists of a combination fiberglass membrane primary throwaway cartridge. The fiberglass provides fine filtration coupled with large dirt capacity; the membrane removes all particles larger than 3 microns and prevents migration.

The primary cartridges are followed by the third stage Rigimesh® corrugated sintered woven wire mesh filter elements which



provide 98 percent 5-micron filtration and absolute 18-micron filtration. The mesh elements protect the system during element changes and in the event the primary cartridges are damaged or omitted.

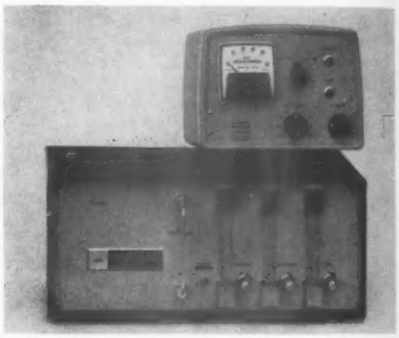
Housings are made of stainless steel and are rated at 125 psi. They are available with the optional Deltadyne differential pressure indicator to show when filter elements need replacement. All design is on an engineered basis. Price and delivery depend on type of unit and quantity ordered.

**Circle #68 on page 51.**

## Ultra-Sensitive Hydrocarbon Gas Analyzer

*Purpose:* A new hydrocarbon gas sampling instrument with provisions for gas flow monitoring and control has been introduced by the Carad Corp., for use with its Fiad flame ionization analyzer and detector.

*Features:* Called Gamad, the instrument permits total hydrocarbon analysis of batch samples from 20 to 40 cc volume, continuous analysis of a gas stream from a pressurized source and gas phase



chromatography with the use of an external chromatographic column.

The Gamad unit is approximately 14¾ in. long, 6⅜ in. high, and 7½ in. deep and weighs approximately 14 lbs.

**Circle #69 on page 51.**

## Powered Acid Cleaner

*Purpose:* Hagan Chemicals & Controls, Inc. has introduced a powered acid cleaner for use in cleaning scale deposits from boilers, heat exchangers, water lines, pumps, and other equipment.

*Features:* Hagan acid cleaner is a free-flowing mixture of a solid acid, corrosion inhibitor, and antifoam. The active inhibitor makes the cleaner safe for use in systems containing iron, steel, copper alloys, brass, and aluminum.

**Circle #70 on page 51.**

*in laying out your client's plant*

**ARE YOU GUARDING AGAINST DUST DAMAGE TO MACHINES?**

Will there be dust-producing machines in your client's new plant? Such as metalworking, wood-working or penumatic conveying equipment? If so, you should plan now for dust control.

Because dust clogs and gums up costly machinery, lowers production efficiency, causes breakdowns and higher maintenance costs. In addition, dust is harmful to the health of employees.

More and more professional men, laying out new plants and remodeling older ones, are specifying Torit Dust Collectors. Torit Dust Collectors have proved 98% efficient in removing dust. They are compact, easy to install and maintain, and cost far less than many types of dust collecting equipment.

Contact a Torit representative. He will give you dust collector specifications, performance charts, dimensional drawings, installation suggestions . . . all the information you need.

Write:

**TORIT**

**MANUFACTURING COMPANY**

*1133 Rankin St., St. Paul 16, Minn., Dept. 1927*

Cyclone model. *Also available in portable cabinet models.*

## New Electrophoretic Support

*Purpose:* New support media for zone electrophoresis has been announced by Gelman Instrument Co.

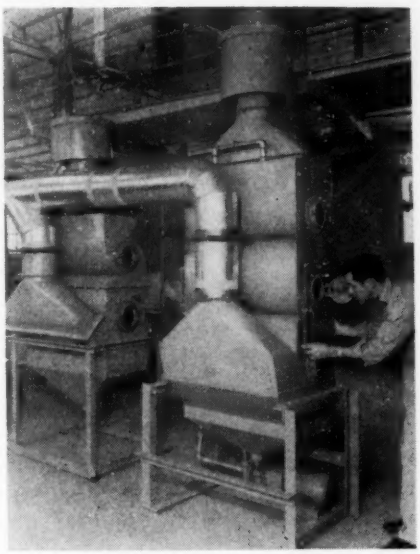
*Features:* Microphore is a microporous cellulose acetate paper-thin sheet made with uniform 3 micron diameter pores. According to Gelman, Microphore, unlike paper, is free of tailing and gives sharp separations.

**Circle #71 on page 51.**

## Variable-Orifice Hydro-Volute Wet Scrubber

*Purpose:* A new variable-orifice, wet scrubber, called a Hydro-Volute Scrubber with air volume control, high scrubbing efficiencies on a wide range of fumes, dust, and odor problems despite substantial variation of air or gas flow, has been developed by Johnson-March Corp. The Hydro-Volute may be used in industry where a dust, fume, or odor problem exists.

*Features:* Both automatic and manual air volume controls are available in a range of capacities of from 1,000 to 60,000 cfm. All units up to 10,000 cfm include a reservoir, liquid level control, moisture extractor and one or



more water-tight access doors as standard equipment. Units above 12,000 cfm are similarly equipped except that no reservoir is required, heavy dust loading and high temperatures necessitate a settling pond.

**Circle #72 on page 51.**

## Combination Mechanical And Odor Filter

*Purpose:* Roto Aire activated charcoal filters manufactured by Burke and Company, filter and purify the air in one operation.

*Features:* Said to be 90 percent efficient on zero to five microns, they are available in a wide range of sizes and may be operated at varying velocities, with various combinations of media.

**Circle #73 on page 51.**

## New Filter For Hi-Volume Air Sampler

*Purpose:* Staplex Company has announced a new filter to improve the operation of their high volume air sampler.

*Features:* According to Staplex the new air filter enables the machine to collect larger samples of air to be tested in a much shorter length of time, thus expediting the entire operation. The filter holder adapters range in size from 6 in. x 9 in. to 12 in. x 12 in.

**Circle #74 on page 51.**

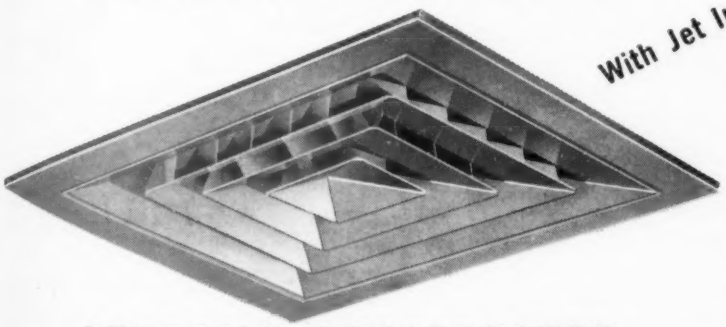
*(Please turn to following page)*

THE ORIGINAL SQUARE AND RECTANGULAR AIR DIFFUSERS

AGITAIR®

GENUINE PRODUCTS

With Jet Induction Diffusing Vanes



STURDILY CONSTRUCTED

- All louvers are firmly welded to diffusing vanes in parallel lines.
- The louvers cannot be tampered with or altered.
- Solid construction eliminates strumming or vibration.
- A metal plate is welded at the corner joints to add greater rigidity to the unit.

MORE THAN 1,000,000 IN USE TO-DAY

Only AGITAIR square and rectangular diffusers employ the jet induction feature due to scientically designed diffusing vanes.

These AGITAIR diffusers with built-in diffusing vanes, are designed and positioned to serve as air pumps, compressing the air into a multiplicity of jets. These jets issuing from spaces between adjacent louvers, produce a high degree of turbulence which rapidly mixes the primary and room air and assures control of the entire cubicle contents of the spaces served.

AGITAIR jet induction type diffusers are custom-made with louver arrangements for 1-2-3 or 4 way proportional blows.

Ask for technical catalog R-108

AIR DEVICES INC.

185 MADISON AVENUE, NEW YORK 16, N.Y.

*BETTER PRODUCTS FOR*

AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

# *New* PRODUCTS

*(Continued from preceding page)*

## Ultrasonic Cleaning Generator For White Rooms

*Purpose:* Westinghouse has announced a new solid state one KW ultrasonic cleaning generator for use in white rooms or other areas where this type of cleaning is applicable.

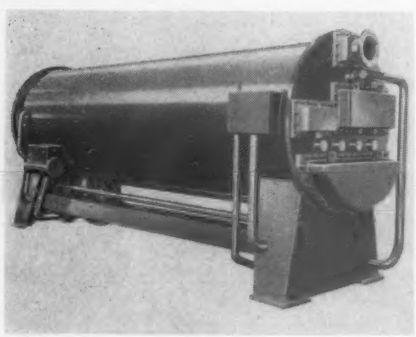
*Features:* According to Westinghouse the KW generator size has been cut 75 percent, its weight reduced by more than 50 percent, and will require 25 percent less power over present tube models.

KW generators will be rated at 125, 250, 500, 750, and 1,000 watts, and will use 115 volt, 60 cycle power at a nominal frequency of 20 kc. It will be 8½ in. high, 17 in. wide, and 14 in. deep and weigh 60 pounds.

**Circle #75 on page 51.**

## "Cold Generators"

*Purpose:* Three new sizes of automatic absorption "Cold Generators," in capacities of 400 tons, 455 tons, and 530 tons, have been announced by The Trane Co. The



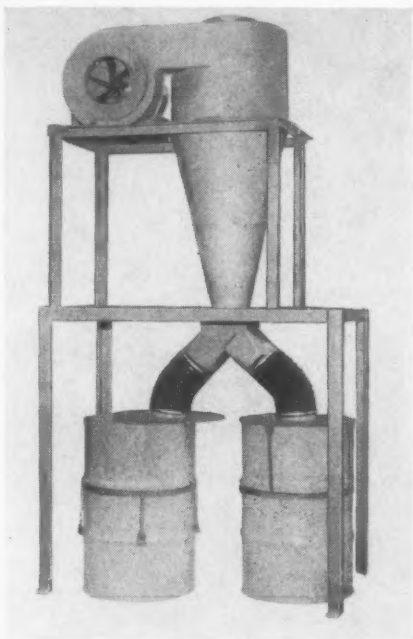
units expand the line to 12 basic sizes in the 100 to 530 ton range.

*Features:* The new sizes feature single-shell, hermetic design arrangement which reduces machine height, permitting installation in low-ceiling areas. The hermetic design prevents air leakage, thus maintaining full-rated capacity and resisting internal oxidation.

**Circle #76 on page 51.**

## New Compact Drum Dust Storage Series

*Purpose:* Aget Manufacturing has introduced a new compact drum dust storage series. The series provides dust discharge directly into conventional 55 gal. drums attached to collectors through a lid.



*Features:* The lid attaches to standard drums by a fast-acting clamp. The clamp fastens a steel girdling band around each drum, and through four stiff springs attaching to lugs on the lid. A sponge rubber gasket forms a tight seal between the lid and the edge of the drum.

Both single and dual drum systems are offered. The dual drum system permits one drum to be emptied while the other continues to receive dust.

The supporting frame of both units is constructed of crossed-braced and welded ¼ in. angle iron. Pads are provided for fastening the units to the floor.

**Circle #77 on page 51.**

## Respirator For Protection From Radioactive Dusts

*Purpose:* Willson Products introduces a respirator for protection against toxic dust, fumes, smokes, and air-borne bacteria.

*Features:* The respirator features: encased R-520 super filter, sealed in clear plastic case; soft rolled edges, chin cup, pleated nosepiece; two natural rubber in-

halation valves inside facepiece admit air during inhalation and become air-tight during exhalation; exhalation valve at bottom of facepiece; complete expulsion of exhaled air, maximum drainage and minimum resistance to breathing; adjustable double elastic headbands; and area for safety goggles or glasses.

**Circle #78 on page 51.**

## Dust-Free Cabinet

*Purpose:* Specialaire dust-free cabinet produced by Specialties, Inc. is designed to solve dust problems in manufacturing gyros, potentiometers, semiconductors, relays, switches, fuses, miniature ball bearings, optical, and precision instruments.

*Features:* The cabinet operates under a continuous flow of double-filtered air. Cleaned air passing out of cabinet acts as a shield against lint, pollen, dust or dust-borne bacteria. The model features a "Packaged Filter Unit" which protects the atmosphere when servicing.

A front hinged panel permits insertion of large work into the 36 in. x 28 in. x 18 in. cabinet. The new Specialaire has an internal electrical outlet and two speed blower to accommodate the use of a microscope through a port in viewing panel.

Circle #79 on page 51.

## High Efficiency Dry Type Air Filter

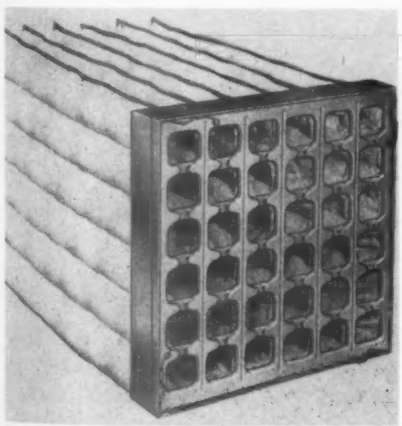
*Purpose:* A new dry-type air filter, the AAF DRI-Pak has been introduced by American Air Filter for use in industrial and commercial ventilating systems, or in central air conditioning systems.

*Features:* The DRI-Pak inflates when the ventilation system is in operation and collapses when the system is shut down, which enables inspection or service from either the air-entering or air- leaving side of the filter bank.

Each 24 in. x 24 in. x 36 in. DRI-Pak filter is rated at 2,000 cfm and provides 95 sq. ft. of filtering media surface. Velocity through the media is 21 fpm.

The cartridge in the folded state is 24 in. x 24 in. x 4 in. deep, disposable, and weighs 4 lbs.

The frame for the new filter is constructed of corrision-resistant galvanized steel and is available in three arrangements: front access with no pre-filter; front access with pre-filter; and rear access with no pre-filter.

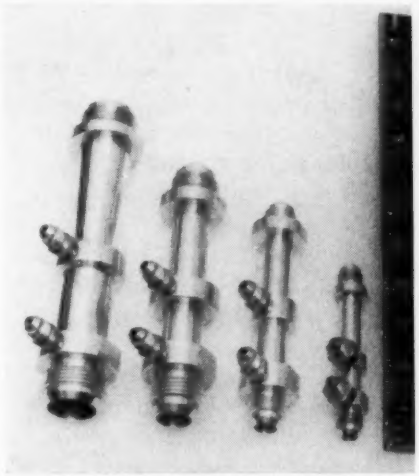


The DRI-Pak is available in three standard sizes: Series 2000, 24 in. x 24 in. x 36 in. inflated; Series 2000H, 12 in. x 24 in. x 36 in. inflated; and Series 1000, 24 in. x 24 in. x 18 in. inflated.

Circle #80 on page 51.

## Venturi Flow Meters

*Purpose:* Flow-Dyne Engineering has designed four typical lightweight venturi flow meters to meet the need for a series of airflow



meters of a single type to cover a wide range of flow rates starting as low as 0.05 pounds per minute with standard inlet conditions.

*Features:* Made in either aluminum or stainless steel with throat sizes from 0.1 in. to 4 in. Standard AN end fittings for tube sizes from 3/8 in. to 3 in. give the degree of utility required in general test laboratory use.

Standard pipe and "V" flange end fittings are available, also precision calibration. Uncalibrated meters with calculated performance curves yielding actual flow rate within 3 percent is available at approximately 40 percent saving.

Circle #81 on page 51.

## Self-Cleaning Lint Arrestor

*Purpose:* Air-Maze Division of Rockwell-Standard Corp. has announced development of a 98 percent efficient, self-cleaning lint arrestor for removing heavy concentrations of lint and fibrous material from air in high volume applications.

*Features:* Called the Lint-A-Maze, the automatic filtering and collection device is available in a wide range of sizes to meet specific air flow requirements from 7,000 to 150,000 cfm. Extremely low pressure drop and high arresting efficiency with velocities of 250

*(Please turn to following page)*

**DRY and CLEAN AIR at the RIGHT TEMPERATURE**

**For Processes or Material Demanding Precise Control, Use Niagara Liquid Absorbent Air Conditioning.**

*This compact method,* giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.

*Most effective because* . . . it removes moisture as a separate function from cooling or heating and so gives a precise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.

*Most reliable because*... the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions...no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

*Most flexible because*...you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

*Write for Bulletins 112 and 131 and complete information on your air conditioning problem.*

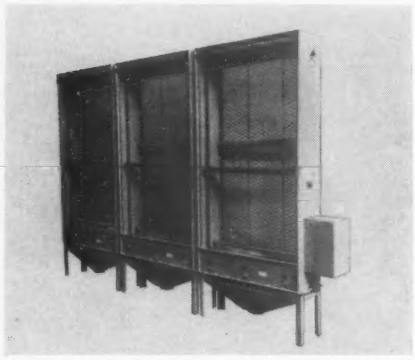
**NIAGARA BLOWER COMPANY**

**Dept. AIR-4, 405 Lexington Ave., New York 17, N. Y.**

*Niagara District Engineers in Principal Cities of U.S. and Canada*

*(Continued from preceding page)*

to 1,900 fpm are features of the new machine. Exact pressure drop depends on which of three standard arrestor medias are used.



A power sweeper brush device continuously removes collected material from the face of the filter media and deposits it in a hopper. Three standard hoppers are available, for automatic or manual collections.

Sizes of standard models range from 2 ft. 10 in. wide and 4 ft. 1 in. high to 21 ft. ¼ in. wide and 10 ft. 3 in. high, exclusive of hoppers and other apparatus.

**Circle #82 on page 51.**

## New Surface Active Compound

*Purpose:* Air Wash Treatment #1, a surface active compound to remove sticky deposits in operating air wash systems and prevent the formation in clean systems in textile mills and tobacco plants, has been developed by Dearborn Chemical Co.

*Features:* Soluble in water, the compound is compatible with standard corrosion and scale inhibitors and biocides normally present in chilled recirculating cooling water.

Dearborn Air Wash Treatment #1 is almost water white and has a mild, spirit-like odor. It is ready for immediate use and is fed to the chilled water by slowly pouring the required amount to a point of rapid circulation. The product is available in 55-gallon steel drums or 5-gallon steel pails.

**Circle #83 on page 51.**

## Dual-Purpose Industrial Ventilator

*Purpose:* Model ER (Dual Exhauster-Recirculator) produced by Genie-Air Products combines both the recirculation of heated air in winter and exhaust of hot air in summer into a single compact unit.

*Features:* During the winter, a Divertco-Damper seals the top of the unit and a 3-position reversing switch controls the direction of the fan. On the recirculating cycle, wasted heat trapped under the roof line is pulled into the fan and blown out the diffuser openings at the bottom.

During the summer, the fan blows the air upward, pulling the hot air into its path and exhausting it outside the building. The Divertco-Damper is lifted up by the air column and seated against the underside of the weather dome.

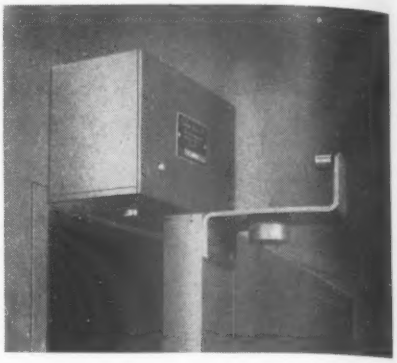
Its conical shape directs the air movement so that it is easily and quickly exhausted without back pressure. Sizes range from 3,000 to 23,000 cfm.

**Circle #84 on page 51.**

## Interlocks For White Rooms

*Purposes:* Folger Adams Company manufactures a series of interlocks which lock two or more doors so only one may be opened at a time.

*Features:* The Electric Bolt No. 40A and 40AL locks the door by means of a continuous duty solenoid. The bolt is withdrawn only



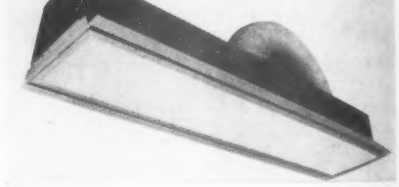
when flow of current is interrupted. The 40AL model includes a limit switch. Alternatively the limit switch may show the closed or open position of a door by means of a signal light, or audible warning device placed at any convenient location.

**Circle #85 on page 51.**

## Air-Handling Troffer

*Purpose:* A complete line of 1 ft. wide and 2 ft. wide air handling troffers with several shielding types are now available from Sylvania Electric Products, Inc.

*Features:* A combination of air diffuser and recessed fixture, the air-handling troffers are designed



as supply and/or return units to meet UL specifications. Troffers using 40 Watt Rapids Start lamps supplied in 1 in. x 4 in. and 1 in. x 8 in. housings with 2 and 3 lamp cross sections plus 2 in. x 4 in. housings with 2, 3, and 4 lamps.

Units accommodate all popular acoustical ceiling types and also include snap-up hangers for fast, easy installation.

**Circle #86 on page 51.**

*For more information use the convenient postage-free cards on page 51.*

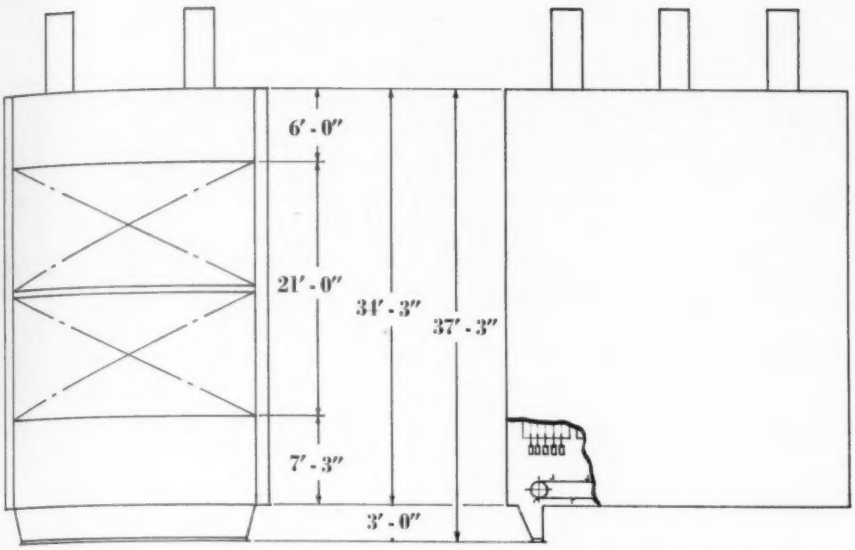



*Fig. 4:* Drag scraper mechanism shown above has advantage of continuous removal of hot dust from single point, minimizing plugging.

## Electrostatic Precipitators

*(Continued from page 30)*

dust densities must be assumed or furnished by the customer.

The AISC design tensile stress for structural steel is 20,000 psi. The yield stress is approximately 33,000 psi. The pressure in the unit may, therefore, withstand surge pressures of about 50 percent over the design without permanent deformation to the steel. Structural steel may be used for continuous temperatures up to 750°F. Above this temperature, consideration must be given to special materials or linings. Temperature does, however, affect the modulus of elasticity of steel and as a result the deflection of the steel exposed to the heat. With temperature surges over design up to 750°F, steel will deflect over design limits but will not suffer permanent deformation. While surges in temperature and pressure to the limits as discussed above will not generally result in permanent deformation to the precipitator steel, it may cause permanent damage to the insulation, depending on type of insulation utilized.

A factor which may vary with competitive bids is the degree of stiffening of the plate area of the unit to accommodate insulation to be applied to the unit. Insulation with transite or metal covering will accept more severe deflection than the plaster coat frequently used. An assumption must be made by each vendor or the information must be supplied by the customer.

Required access, both internal and external, are factors which affect the size and cost of the unit. Need for access should be weighed against cost of the facilities as well as the space consumed. Actual installations vary from practically unlimited access to extreme compactness, generally reflecting past problems or lack of problems with existing equipment. The vendor will generally furnish the minimum access required for proper maintenance unless otherwise specified.

A multiple chamber precipitator with split duct and appropriate dampers for by-passing individual chambers may be a consideration where downtime of the unit may penalize system operation or cause an unscheduled system shutdown. The multiple chamber unit will permit entry of any chamber while operating at slightly reduced efficiency through the remainder of the unit. A multiple chamber unit is also desirable where gas volumes vary, permitting use of only part of unit at near rated velocities.

In summary, the physical factors such as pressure, temperature, dust density, dust removal system, dust storage, duct arrangement, degree of accessible, desired flexibility, insulation, and space limitations are all factors determining the size and cost of the precipitator. ▲▲

GP-100 . . . a new line of standard-dimensional, precision-crafted work tables . . . created after on-the-spot studies of today's exacting white room requirements.

**ALL THE MOST WANTED FEATURES**

- adaptable — fits any space, fills any production requirement
- durable — rugged steel frame for strength, stability, permanence
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- sanitary — smooth surfaces, dust-trap free for white room use
- versatile — efficient clip-on tops allow swift changeovers
- economical — saves on cost of installation, requires no maintenance

SWAP TOPS

BROCHURE ON REQUEST. LEITCH-HUARD CORP., COMMERCIAL STREET, MANCHESTER, N.H.

something NEW you should know about "CLEAN" ROOMS

**This four-page bulletin**

describes a new service which provides complete, pre-engineered "clean" or "white" rooms in one package at one price — including installation and employee training. 31 construction and operational details of a typical dust-controlled clean room are illustrated.

*Write for your free copy*

**Controlled Environment, Inc.**
52 Pickering Street ◆ Needham 92 ◆ Massachusetts


### Basket Filter Ventilation

*(Continued from page 32)*

be closed and observation openings if necessary should be located toward the outed or rear of the cover. A control velocity of 100 fpm will usually provide satisfactory control. The same general design may be used for underdriven centrifuges.

Filtered solids from the overdriven centrifuge are discharged through the bottom of the centrifuge after the product is scraped from the sides by a plow. If the solids contain residual irritating or toxic vapors, control may be required. Enclosure of the bottom of the centrifuge as shown in Fig. 3 will provide the desired control. A control velocity of 100 fpm through hood working openings should be maintained to realize satisfactory control.

In some centrifuge operations, where extremely toxic or irritating materials are used, it is required that no contact with the product occur. Fig. 4 shows a complete enclosure to realize this condition.

The front of the hood is closed with a glass or plexiglass cover. Filling and washing operations which are done at high speeds are performed using valves outside of the enclosure. Plowing may be done with the cover removed since this is usually done at slow speeds with little chance of spray or splash. A control velocity of 100 fpm will usually provide satisfactory control. ▲▲


**SPECIAL CHAIRS FOR WHITE ROOMS AND DUST FREE AREAS**

- All Enclosed Mechanism
- No Oil or Grease
- All Chrome Plate Finish
- Easily Cleaned
- 12 Ga. All-Steel Seat; 14" x 15⅝"— Waterfall Form. Sand Blast Surface. Adjusts 18" to 26".
- 12 Ga. Steel Backrest; 6" x 13¾"—with tempered steel backrest support. 6 inch horizontal adjustment. Backrest folds down to make easy cleaning.
- Cast Iron Base; 20-inch spread. 1½" steel glides.

Other White Room chairs with lacquered plywood seat and backrest.

**FREE TRIAL** Use an AJUSTRITE chair for 30 days without obligation. Prove to yourself the many advantages AJUSTRITE offers in comfort, utility and economy. Write today—we'll do the rest.

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## Industrial Hygiene News

*(Continued from page 19)*

### Rocket Propellants

Many of the chemicals listed are used in propellant research and development. The values vary from 0.005 ppm to several hundred ppm. Hence, adequate laboratory ventilation is a primary concern in our safety program.

"In addition to the toxicity hazards in the laboratory, we should also be concerned with other potential hazards such as detonation, spontaneous ignition and corrosion."

"Handlers must respect, but not fear, what they handle. If the operating personnel are properly trained, have adequate safety indoctrination and are provided with proper protective clothing and equipment, the field of rocket propellant research and development can be as safe as any other field of chemical research but everyone must think and live 'Safety'."

*Use the Communications Center, page 51, to receive more information about any product advertised, any new literature or new product described. Circle the number on the postage-free card that refers to the item of your interest, add your name and address and mail.*

*To comment or make suggestions about any article in this issue, use the Editorial comment card.*


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L. B. Hitchcock.....Edwin Cox
John H. Schaefer, Technical Advisor
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RATES—Classified advertising is run in 6-point type (this size) under suitable headings. Minimum rate $5.00 for forty words or less. Extra words .15 each. Box addresses, with usual services, count as five words. Payment required with order. No agency commission, no checking copies. Closing date first of month preceding month of issue. No proofs will be submitted prior to running, but proof will be forwarded for record. No display advertising under classified headings. AIR ENGINEERING, 450 W. Fort Street, Detroit 26, Mich.

**POSITIONS AVAILABLE**

ENGINEER — VENTILATING: Farm buildings. We need a thoroughly competent man experienced in air movement with experience on air intakes, fans, thermostats and timers. This man must know design and be experienced in training salesmen and qualified to organize and train a sales force in a 5-state area. Local office, limited travel, liberal salary and override. Experience equivalent to a degree acceptable. WRITE BOX AE-4611, Air Engineering.

DUST COLLECTING Engineer — AAAA Ohio manufacturer is seeking an engineer with a minimum of five years' experience in the application and sales of industrial dust collecting equipment. This is an unusual opportunity in a newly created product line. Give full background in letter directed to BOX AE-4612, Air Engineering.

The "Cyclonaire" is a surprisingly compact wet bed scrubber. It will fit almost anywhere, but it does a fume removal job formerly possible only with expensive custom-designed units. Removal of many gases (of 1% concentration or less) is up to 99% effective. Low power requirements make it very economical to operate.

The "Cyclonaire" is available fabricated either from 12-gauge steel, lined with 3/32" thick Tygon sheet plastic, or from fiberglass re-inforced polyester resin. The lined-steel unit comes complete with a top-mounted blower equipped with a rigid polyvinyl chloride (PVC) rotor. The lighter weight fiberglass re-inforced polyester unit utilizes a separately mounted blower duct-connected to the unit.

Both units are shipped complete with the necessary packing — Intalox porcelain saddles, metal or poly propylene Pall Rings—depending upon the corrosive conditions or weight limitations existing.

The "Cyclonaire" is available in four sizes with rated capacities of 750, 1650, 3500 and 6000 cfm.

Its low initial cost, its low operating cost, its high efficiency make the "Cyclonaire" a logical choice for a wide range of fume scrubbing operations. Full technical data in Bulletin FW-10R. Write for it today.

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